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☞ An asterisk (*) denotes an illustrated article

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Marine Sounding-Line.—M. Ch. Tardieu employs a spherical envelope of caoutchouc, communicating with an iron reservoir by means of a small tube which is provided with a valve. The envelope being filled with mercury, any increase of external pressure forces into the reservoir some of the mercury, which cannot return on account of the valve. The weight of the mercury determines the pressure, and consequently the depth of the water.—*Jour. Franklin Institute.*

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

The Semi-annual Meeting of the Association will be held at the Rockingham House, Portsmouth, New Hampshire, on Wednesday, August 15, 1877, at 12 o'clock, noon.

The first day and evening will be devoted principally to business. On the second day an excursion to the Isles of Shoals is proposed, with a banquet upon returning, giving members and their friends an opportunity to return home by the afternoon or evening trains.

GEO. B. NEAL, Secretary.

VOLUME XXVII.

With the July number we commenced the 27th volume of the Journal. The steadily increasing patronage, as well as the many expressions of approval which we receive, is the best token of the satisfaction which the paper gives our readers. It is our purpose to continue in the course which we marked out at the beginning, and which we have steadily followed, viz., to make this a gas maker's paper, and to give our readers the benefit of all the improvements which are developed from time to time, and which are based on such true scientific principles that there is a probability of their being of real value.

We feel perfectly assured of one thing, that while the coal gas interest is by far the largest one with which we come in contact, that, at the same time, there is no class of men who watch the progress of the age more carefully than they do, and who would so quickly adopt any improvement that would enable them either to give a better gas for the same money, or as good for less money.

It is very easy to cry "prejudice," "old fogy," "antiquated"; but the assertion does not establish the fact, unless made by better authority than those who generally indulge in epithets instead of argument and facts.

The extravagant ideas of profits existing in the minds of many, (not large stockholders in various gas companies) have led them often to decry that of which they had no knowledge, while the desire to accumulate rapidly from what was supposed to be a rich corporation, has led to no end of attempts at blackmailing in every conceivable form. Patents by the hundred, and processes by the score, have been sold under various threats. It is to be regretted that so many companies have bought them, for in most instances they have only served to increase the amount of useless expenditures. An idea seems to exist with some, that if a business is profitable, it must be overthrown at once. We are not yet ready to endorse this idea any more than we are the theory that a poor process is better than an old one, simply because it is new. That there is much to be done to make the old process of making gas from coal more perfect than at present, we have often shown in these columns—and no gas manager can afford for a moment to relax his efforts to continue the steady march of progress that has been going on for the past seventy years. To assist to the extent of our limited ability, all those who are conscious of this fact, is our constant endeavor. But, for those who have "learned it all," or who are disposed to sit still and vegetate, we trust that we shall have little to offer. And if they are occasionally taken in by fraud and misrepresentations, we trust that it may serve to awaken within them a *true* interest in the science of gas making.

LABOR vs. CAPITAL.

The past two weeks has witnessed another of those attempts to regulate the price of labor by force, which have hitherto been more characteristic of special localities than of the land in general; but in this instance the manifestation of *unreason* seems to have been more widespread than at any other time in our history. The result has been a triumph of law and order, and as usual in strikes, with no gain to the strikers. Millions of property were destroyed, not by working-men, but by those who are ever ready to seize upon any opportunity offered, by a disturbed state of affairs, to commit violence under the popular cry of the movement.

In the State of New York the State authorities have shown themselves able to cope with the troubles, so far as they existed or threatened to occur within her own territory.

If other States had been as ready, prompt and decisive in their action at the first outbreak of the difficulty, there is a strong probability that the nation would have been spared the unenviable notoriety that it has attained in this connection.

The old principle, that labor as well as money, or anything else, is worth just what it will bring in the market, has not yet been overthrown, but rather more firmly established by recent events. All that remains to be done to establish the full supremacy of legally constituted authority, is to bring to punishment all who have violated law.

In only one instance that we have heard of has

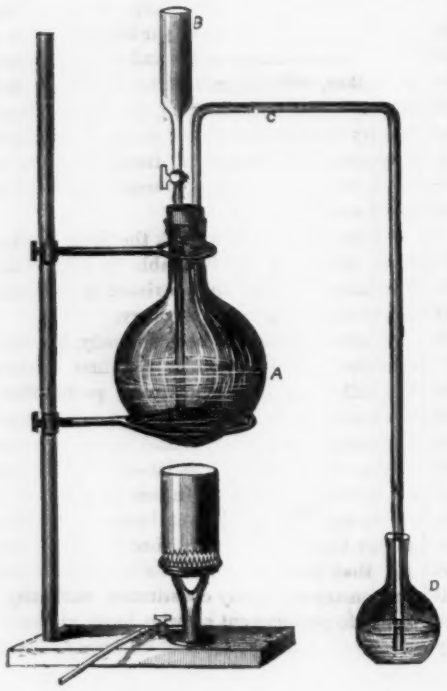
any gas company been directly affected by the strikes, and that was the Laclede, of St. Louis. A reduction had been made in the pay of the men just previous to the railroad difficulties, and they availed themselves of the general tumult to strike for a restoration of their pay, which, under the circumstances, the company were obliged to give them for the present.

The probability is that if the proper course is pursued, by those in authority, a similar attempt will not be made again. There is a reasonable way of correcting all disputes. But if any man is not satisfied with the compensation he receives for his labor, he has no right whatever to interfere with those who are willing to work for the same or less pay. While every man is the master of his own labor, which is, in fact, his capital, he has no right whatever to attempt to control that of another.

On the Valuation of Gas Liquor.

The knowledge of the presence of the so-called "fixed ammonia" in gas liquor—that is, of ammonia in a form not indicated by the ordinary acid test—has long necessitated the introduction of a more correct method of valuation, by which the whole of the ammonia contained in the liquor, irrespective of the form in which it is present, should be capable of direct estimation. The process which would almost naturally suggest itself to any one conversant with the subject would be distillation with an alkali, and this method is, in fact, the only practicable mode of obtaining the *whole* of the ammonia from gas liquor in a form which admits of its being directly estimated.

The object of the present article is to describe a form of apparatus which appears to be the simplest distillation process which could possibly have been contrived—a process in which the facility of manipulation renders it possible of accurate performance by any ordinary workman of average intelligence, and in this wise, therefore, as applicable to the desired purpose as the old and erroneous method of valuation by the employment of test acid, applied to the gas liquor direct. The method about to be described is now in practical use at the Phœnix Gas Works, and was contrived by Mr. Thomas Wills, the chemist to the company.



The arrangement of apparatus employed is represented in the diagram, where A is a glass flask of about 16-ounce capacity, provided with a closely fitting india-rubber stopper. Through this stopper passes the tube of the long funnel, B, which is provided with a glass stopcock, and likewise the tube, C, which is bent twice at right angles. The extreme end of the tube is slightly tapered, and dips into a 4-ounce flask, D. The body of the funnel, B, is graduated to deliver two ounces. The other apparatus required is a burette, with glass stopcock holding two ounces, and being divided into 32 equal parts, the graduations commencing from the lower part of the instrument; and two pipettes, one of 1-ounce capacity, and one graduated to deliver 2 ounces.

The test solutions used are three in number—viz., the ordinary 10 per cent. sulphuric acid, such as has been always in use for the valuation of liquor; a solution of ammonia of such strength as to neutralize an equal bulk of the test acid; and, finally a solution of caustic potash or soda, which may conveniently contain about 10 per cent. of either alkali. The two first-named test solutions should be made to correspond accurately with each other, but the potash or soda solution needs no precision in preparation.

The method of procedure is as follows:—One ounce of the liquor to be examined is introduced into the flask, A, being either measured by the graduated funnel, B, or, in cases where greater accuracy is required, the measurement should be made by means of the ounce pipette. The liquor is washed down with a little distilled water, and one ounce of the caustic potash or soda solution is then added, followed by about four ounces of water. The flask, D, is then charged with two ounces of test acid (measured by the pipette), and the apparatus is ready for use. Heat being applied to the flask, A, until the contents have reached the boiling point, brisk ebullition should be maintained for about fifteen minutes, at the end of which period the whole of the ammonia in the liquor will have distilled over into the flask, D, and have been there absorbed by the standard acid The distillation being complete, the flask, D, is removed, a small quantity of tincture of hematine added to its contents, and the standard ammonia run in from the graduated burette until the change of the color of the hematine from yellow to crimson indicates that all the excess of acid present has been neutralized. *The number of divisions remaining in the burette then indicates the "total ounce strength" of the liquor under examination.*

The main feature of novelty in the process above described consists in entirely dispensing with the use of a condenser, by which not only is the apparatus much simplified, but made more generally convenient. It might be thought that without proper means for condensing the ammoniacal vapors evolved during the distillation, a loss of ammonia would have taken place which would naturally have vitiated the result, and rendered the experiment valueless. Such a loss is, however, found in practice not to occur, and repeated experiments have proved that no loss of ammonia whatever takes place during the distillation, the absorption of the ammoniacal vapors by the test acid being complete even to the extent of being theoretically accurate.

The adjustment of the standard solutions used is also of great advantage in simplifying the test, more especially as the 10 per cent. now in use is made available for the purpose. A little thought will enable the reader to perceive the reason why the strength of the liquor under examination should be at once indicated by the number of divisions of test ammonia left in the burette at the conclusion of the experiment. As the test alkali is of equivalent strength to the test acid—that is to say, that equal bulks are required for neutralization—it follows that the bulk of test alkali left in the burette is really a direct indication of the measure of acid neutralized by the ammonia in the liquor, and thus of the strength of the liquor.

In the ordinary process of valuing gas liquor, equal bulks of the liquor under examination and of test acid are taken, and the latter gradually added to the former until neutralization occurs. If the whole of the test acid is required, the liquor is of 16-ounce strength, and consequently, if one ounce of liquor be taken, each 1-16th of an ounce measure of acid equals one ounce strength of liquor. It is obvious, therefore, that when one oz. of liquor is subjected to distillation, and the ammonia evolved conducted into two ounces measure of the test acid, if the whole of the latter had become neutralized the 1st drop of test alkali added would change the color of the hematine, and the liquor (reading from the burette divisions) would be of 32-ounce strength. If, on the other hand, it is assumed, for the sake of argument, that the liquor placed in the distillation flask contained absolutely no ammonia, it would be found, on the completion of the experiment, that the full measure of test alkali would be required to neutralize the contents of the small flask, and the liquid in the burette would stand at 0. The process will, therefore, indicate the strength of any sample of gas liquor up to 32-ounce, which is sufficient margin for all ordinary purposes. It is found to work well in practice, and the results are accurate.

Finally, taking into consideration the great value of gas liquor as a residual product, it needs but little to be said by us to urge upon gas companies the importance of basing all future liquor contracts on the *total* ammonia present, which can only be properly ascertained by the rejection of the old system of testing, and the adoption in its place of some such method as that which we have just described.—*Jour. of Gas-Lighting.*

Cantor Lectures.

The Chemistry of Gas Manufacture.

By A. Vernon Harcourt, Esq., M.A., F.R.S.
Lee's Reader in Chemistry at Christ Church, Oxford, and one of the Metropolitan Gas Referees.

[From the London Journal of the Society of Arts.]

Second Lecture.—Monday, March 12.

The condensation, as it is called, of coal gas consists in cooling the products of the destructive distillation of coal to the temperature of the atmosphere. A separation is thus caused between those portions which remain gaseous at this temperature, which becomes the common temperature of all the intermixed gases, and at a pressure which is different for each gas, and those portions which are liquefied under these conditions. The pressure to which each gas is subjected is the atmospheric pressure, minus the tension of all the other gases.

This separation is not a separation of different kinds of matter one from another, but of different portions of the same kinds, each kind dividing itself between the gaseous and liquid product in a proportion depending upon its specific volatility or solubility. So completely is this the case, that, of all the substances forming the crude heated gas, there is, probably, not one which does not divide itself, however unequally, between the portion which remains gaseous and that which becomes liquid when the crude gas is cooled. Some hydrogen, to take the extreme cases, is dissolved in the liquor, and some vapor of the solid

hydrocarbons remains in the gas. One or two of the more volatile hydrocarbons, such as benzol, probably divide themselves pretty equally between the condensed liquid and the gas.

I have here a drawing of a set of gas retorts, showing the position which the retorts occupy in the furnace. They are long boxes of fire-clay, very often made in the shape here shown—the shape of the letter D, with the straight side downwards, sometimes closed at the far end, and sometimes open at both ends. Into these the coal is put, either thrown in with a shovel or thrust in with a scoop. Then a lid is fixed air-tight over the mouth, the temperature being kept constantly at bright redness, so that for five or six hours the coal is exposed to this degree of heat, the maintenance of which is essential to the production of a large quantity of gas. The only issue for the gases, formed from the heated coal, is by the ascension-pipes, which pass upwards from the mouthpieces of the retorts. Through them the gas passes, and thence enters a large and long pipe, into which the ends of the smaller pipes descend for a certain distance, so as to open below the level at which the condensed liquid runs off. This pipe remains partly full of liquid, consisting chiefly of the less volatile portions of tar, and the gas, as it is formed, bubbles through the liquid, and so goes off.

What I propose now to follow is not the permanent gas, but that which becomes liquid when the heated mixture of gases is cooled. Some of this liquid is deposited, as already mentioned, immediately on leaving the ascension pipes, and forms the first portion of what is separated from the gas by condensation. The gas, however, is still quite hot when it leaves the hydraulic main, as it is termed. It passes from thence through a system of pipes so arranged as to present a large cooling surface to the gas, in order to the more complete separation from it of those parts which are liquefiable. The drawing represents an arrangement of the condensers, in which the gas ascends in one pipe and descends in the other, so that it is exposed during its course through a considerable length of piping packed into a small compass to the cooling influence of the air, the heat of the gas traversing the sides of the iron pipe, and thus an exchange of temperature between the gas and the surrounding air going on during the whole of the passage. Under these influences a further portion of liquid is condensed out of the gas, which runs down into a tank, and is collected in a well beneath. The liquid divides itself into two parts, a lower layer of tar, of the nature of which I gave you some account in my last lecture, and an upper layer of water holding various substances in solution, which is commonly called gas liquor, or ammoniacal liquor, of which I have to speak to-night.

A list is placed on the wall of the substances derived from the destructive distillation of coal, and I will refer to those which are found in gas liquor. At the head of the list comes water, which is the first substance given off when coal is heated; and it is by its solvent action that many other substances are removed from the crude gas at this stage.

The compounds of hydrogen with carbon are sparingly soluble. Hence in spite of the abundance of these substances in coal gas, very little of any of them dissolves in the condensed water. The compounds of hydrogen with nitrogen and with sulphur are both soluble in water, and the substance produced by their union is soluble. Carbonic acid also dissolves in water to some extent, and abundantly in water containing ammonia. By the action of ammonia upon carbon bisulphide, ammonium sulphocyanide, another soluble salt is formed. In some coal mines a stream of salt water has been found, and chlorine, probably existing as sodium chloride, is an element present in small quantities in the ash of coal. Like the elements already named—carbon, oxygen, nitrogen, and sulphur—chlorine escapes from the heated retort in combination with hydrogen, and this compound, or rather the product of its union with ammonia, is found in gas liquor.

Acetic acid, which is produced largely by the distillation of wood, is also formed in small quantity from coal, and dissolves as ammonium acetate. The presence of sulphate of ammonia, to a small extent, may be due either to oxidation of sulphur compounds in the heated gas, or to the subsequent action of the air upon the sulphur compounds in solution. Of this latter action, the principal product is a salt, corresponding to the sodium salt used as a "fixing" agent by photographers—ammonium hyposulphite. Another secondary product of a reaction between the cyanides of the liquor and the iron of the condensing-pipes, is ammonium ferrocyanide.

I come now to the treatment of this ammoniacal liquor. It is a substance of which the value was at one time not appreciated. It used to be got rid of, and probably still is so at many gas works, as a waste product. But commonly it is converted into sulphate of ammonia, either at the works, or by the chemical manufacturer.

From the tank in which it is stored, it is pumped to the top of a vessel, like that which at gas-works is called a "scrubber"—a tower filled with coke or pebbles, or it may be an arrangement of alternate shelves, down which the liquor trickles, exposing a large and constantly renewed surface. The liquid runs off from the bottom of this tower into a tank or boiler, and into this tank or boiler there is blown a current of steam, and there is also injected a little stream of milk of lime.

Let us consider first what passes in the tank. There the liquor, which has already lost a part of its ammonia, is strongly heated by the steam which is blown into it, and it is also exposed to the action of the lime. Lime decomposes the substances of which I was speaking just now, sometimes called the fixed salts of ammonia, substances which contain ammonia in a condition in which heat alone will not drive it off. A mutual decomposition takes place between these salts, such as ammonium chloride and sulphate, and the lime which is in the tank; and salts of lime are formed, and ammonia is driven upwards with the steam.

This steam, then, already mixed with ammonia, passes into the tower, and as it rises up meets a descending stream of gas liquor. The proportion between the two is such that the high temperature of the steam reaches just to the bottom of the tower, and when the liquor that comes over meets the ascending heated current, it gives off at once so much of its ammonia in a free condition, as is combined with substances which leave it still volatile. So that from the top of the tower there passes over a quantity of gas, consisting of ammonia and the volatile acids which were combined with ammonia, principally carbonic acid and sulphuretted hydrogen.

These gases are conducted into a wooden tank lined with lead, which is filled with sulphuric acid, the ordinary brown oil of vitrol, and there the ammonia is condensed. It combines at once, producing great heat, with the sulphuric acid, and as the quantity accumulates, it crystallises in combination with the sulphuric acid as ammonium sulphate. I have here a specimen of gas liquor before treatment, and a specimen of the salt which is formed from it. This is the white sulphate of ammonium which is got by the process I have described. The carbonic acid and the sulphuretted hydrogen are got rid of either by conducting them to the bottom of the furnace of the works, so as to destroy the sulphuretted hydrogen, or else by passing them through a purifier containing oxide of iron; or else, which is the best plan, the gases are burnt, and the products mixed with nitrous fumes, are passed into lead chambers, and thus the sulphuretted hydrogen is converted immediately into sulphuric acid by the same process by which the vitriol maker converts native sulphur, or iron pyrites, into sulphuric acid.

It is a question of some importance in what way the ammoniacal liquor, which is sold by the gas manufacturer to the chemical manufacturer, should be estimated. The ordinary way, I believe, of estimating its value is by mixing directly the ammoniacal liquor with sulphuric acid, and observing how much acid of a known degree of dilution must be added to a measured quantity of the liquor before it is completely neutralized. The strength of the liquor is ordinarily described by a statement of the quantity of sulphuric acid that a gallon of it is capable of neutralizing, so that the expression 10-ounce liquor means that a gallon of the liquor contains ammonia enough to exactly combine with and neutralise 10 ounces by weight of sulphuric acid. The direct determination of ammonia in this way gives a very imperfect and unequal estimate of the value of the ammoniacal liquor. Imperfect, for the reason that besides free ammonia and compounds of ammonia with weak volatile acids, which alone neutralise the sulphuric acid, the ammoniacal liquor contains also, in the form of neutral salts, combined ammonia, which is got out of it, and turned to account by the chemical manufacturer, and which is not estimated by this mode of testing, because the proportion of free to fixed ammonia appears to vary greatly in different samples of liquor. Therefore it must be very much better, and I have no doubt it will ultimately become the general practice, to use some means of determining the value of ammoniacal liquor more exactly. The most obvious way of doing it is by means of such an apparatus as I have here set up.

It consists of a little flask connected with a Liebig's condenser, in which the steam formed on boiling the liquid in the flask passes along a narrow tube surrounded by a larger tube, through which cold water is kept flowing. The ammonia from the liquor, and from the fixed ammoniacal salts—for I have placed in the flask besides ammoniacal liquor a small quantity of lime—passes along the inner tube. It is dissolved by the water which distils with it, and drops into the colored liquid which has been placed beforehand in the receiver into which the tube passes. The liquid is dilute sulphuric acid, a measured quantity of an acid of known strength, colored with a little litmus. I have taken, for convenience of calculation, 16 c.c. of ammoniacal liquor, which, before being distilled, was mixed with twice its volume of water. In the receiver I have placed 16 c.c. of the standard acid which is commonly employed—namely, the acid which contains one pound of strong sulphuric acid in one gallon of dilute. This measure of acid will be sufficient to neutralize all the ammonia that can be given off, unless the liquor is more than 16-ounce liquor. It is only necessary to carry on the distillation until about one-third of the liquid in the flask has passed over. At the outlet of the receiver is a tube

with two bulbs blown upon it, which hold a little of the liquid. By turning it round, it is made to serve also as a funnel for bringing the acid into the receiver. At the end of the distillation this tube is turned round, and the liquid which is in the bulbs runs back into the body of the receiver. By substituting a solid cork for that which holds the bulb-tube, and removing the receiver with its contents, and running in standard ammonia from a burette till the litmus changes color, the quantity neutralized, and the quantity of ammonia in the volume of liquor operated upon, are known.

[To be continued.]

British Association of Gas Managers.

The Fourteenth Annual General Meeting of the Members of this Association was held on Tuesday, the 12th, and Wednesday, the 13th inst., at the Lecture Theatre of the Bristol Museum, Queen's Road, Bristol—Robert Paulson Spice, Esq., Memb. Inst. C. E., the President, occupying the chair.

TUESDAY, JUNE 12.

The President took the chair at ten o'clock this morning.

The minutes of the last general meeting, and the financial statement for the past year, having been previously printed and circulated amongst the members, were taken as read, and, on the motion of the President, were approved.

The President then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—I thank you sincerely and heartily for the honor you conferred upon me at your last annual meeting in the Metropolis, by electing me to occupy the presidential chair on the occasion of your coming this year to this ancient and important seat of commercial and manufacturing industry, to discuss those objects which claim our special attention as a scientific institution.

ADVANCE IN THE SCIENCE AND PRACTICE OF GAS LIGHTING.

In the year which has passed since we last met, there has been no flagging in the exertions which the active spirits among our members have of late years been accustomed to make in the constant pursuit of improved methods of gas manufacture; the objects at all times kept in view being, the reduction of cost, and the improvement of the quality, of the manufactured article, the scientific and the practical being thus directed to secure the best possible commercial results.

It does not always happen that these exertions are estimated at their full value by the general public, or by those who, in large towns and cities, are entrusted with the direction of public affairs; but that does not furnish a sufficient reason for any relaxation of our efforts. It is our duty to be "instant in season and out of season," and, sooner or later, devotion to duty will be crowned with success.

The nature of the case is such, that a gas company occupy of necessity a position which, of all others, is calculated to beget in men's minds, suspicion and distrust. The supply of gas to a town or city being unavoidably a monopoly, any one requiring a supply, and having at any time a grievance, either fancied or real, against the company, cannot obtain relief by going to a shop over the way, or round the corner, and this too frequently gives rise to a feeling of antagonism which is difficult to remove, and has often resulted in furnishing employment to unscrupulous agitators, ready to promise *anything*, but competent to do *nothing*, but mischief;

The true remedy for this state of things lies mainly with yourselves, and I beg you will bear with me, while I endeavor to point out the course to be steered, to avoid exciting the public mind prejudicially, and secure that spirit of satisfaction and goodwill which contributes, where it exists, so largely to the prosperity of gas companies.

THE EDUCATION OF A GAS MANAGER.

The first step in this direction is for a manager to obtain a critically accurate knowledge of his art; I say art, advisedly and intentionally, for gas manufacture has really become an art, whereas it was formerly, and long within my own recollection, merely a rough-and-ready, and too often slovenly conducted, business. As a rule, all that was thought requisite, not very many years since, was to charge a retort with coal, keep up such a heat as would suffice to drive out all the gas in six hours or so, and then draw the resulting coke, the gas having been driven through an apology for a condenser, and so much lime as would prevent its blackening test-paper or a bit of silver, and sent into the gasholder, measured or unmeasured. As to any accurate knowledge of exact results, it was out of the question, not dreamed of in the philosophy of the gas managers of those easy-going times.

But a change has come o'er the spirit of the dream. The times are altered, men's witts have been sharpened, the voice of popular opinion has been heard and felt; what may be called gas literature has become widely spread; every session of Parliament has produced important additions to the vast amount of evidence placed on record as to what can be, and is, done in cheapening and improving the supply of artificial light; and thus is made clear the fact, that the gas manager of to-day must, if he is to hold his own, be an intelligent and painstaking man, well informed on all matters relating in any degree to the one subject, above all others, claiming his attention in a business point of view—namely, LIGHT.

The subject itself is vast, and should be regarded comprehensively; and, although it may appear to be an extreme view, I cannot shrink from the expression of my opinion, that a gas manager should aspire to a scientific knowledge of the material structure of the globe, its place and its path in the universe, and attain to such a degree of familiarity with the sciences of chemistry, geology, and astronomy, as may enable him to bring to the practical and every-day labors of his life, the aid of those great principles which are involved in, and underlie, the solution of the problems which naturally arise, and require his skill in the determination of the right direction to be given in his dealings with the various forces of nature, intimately connected, as they undoubtedly are, with his common avocations, demanding the economical adaption of the means to the end to be accomplished.

And these being the primary objects of his professional life, I would suggest that he would do well to have on his book-shelves Kingsley's "Town Geology," an elementary and popular work, treating of the soil of the field, the peebles in the street, the stones in the wall, the coal in the fire, the lime in the mortar, and the slates on the roof; the works of Hugh Miller, entitled "My Schools and Schoolmasters," "The Testimony of the Rocks," and the "Old Red Sandstone;" Faraday's popular lectures "On the Various Forces of Nature," and the "Chemical History of a Candle;" "Notes of a Course of Nine Lectures on Light," delivered at the Royal Institution in 1869; and "Six Lectures on Light," delivered in America, in 1872-73, by Tyndall; and Herschel's "Outlines of Astronomy."

These several works contain almost inexhaustible and measureless mines of intellectual wealth, calculated to raise the conceptions, expand the intellect, and enlarge the resources of the gas manager, place him above the common level of his fellow-townsmen, and make his power felt by them, to a degree, and in a way, in which it could not otherwise be, quite as much to their advantage as his; and thus it would, in his own experience, prove the truth of Lord Bacon's aphorism, that "knowledge is power," always assuming that the knowledge is accompanied by the twin virtues, discretion and courtesy.

The chemist, the geologist, and the astronomer, each furnish all-important aids to the gas manufacturer and manager, enabling him to trace effects to causes, make the best use of materials, direct his choice in their selection, and produce the best attainable results; unfolding the treasures of the material world which we inhabit, throwing light upon its progress towards what it now is, from what it once was, many millions of years ago, before the dry land appeared, and before the command went forth from the Great Architect of the Universe, "Let there be light."

The astronomer, opening to our wondrous gaze not only the position and courses of those planets, which, like our earth, perform, each in its own appointed time, the circuit of the central luminary which gives us light and heat by day, but teach us that outside our planetary system, there are countless myriads of worlds in the infinite space which we call the heavens; those which we can see, but whose distance we cannot measure, and which we call fixed stars, being, in all probability, suns and centers of life and light to systems of worlds, the light from which has not yet reached us, although traveling at the rate of 186,000 miles a second. All such knowledge must tend to furnish our minds with food for reflection, and inspire us with thoughts, concerning not only the finite, but the infinite, while we are dealing with created matter, and disinterring from the bowels of the earth, those carboniferous treasures which represent the buried vegetation of a period so remote, that the geologist can only estimate, but entirely fail to measure or determine, its age.

THE DISSEMINATION OF INFORMATION AMONGST GAS CONSUMERS.

The next desirable state of things to the possession of an extensive and accurate acquaintance with scientific knowledge, is the acquisition of a faculty for communicating and spreading that knowledge among one's fellow-men in our individual spheres. The peculiar demand of the times is, as Hugh Miller states in his "Testimony of the Rocks," that "what a man knows of science and art, he should freely communicate to his neighbors;" and the faculty of doing this may be acquired by practice, if it be not an inherent power.

In regard to this principle of action, we have in our Association many pleasing and encouraging examples, the evidences of which I am proud to point to, in the many valuable papers which have been contributed from time to time, and which are already enrolled in the records of our Transactions; and this list, I am happy to find, will receive important additions, at this our fourteenth annual meeting. It has been customary to refer to these papers from the chair, at the commencement of the meeting; but as I do not see the necessity for such a notice, inasmuch as each member has been furnished with a list of them, I shall so far depart from the custom, by honoring it in the breach, instead of the observance, and merely say, that I feel grateful to each of those gentlemen who have prepared a paper, which is, in fact, in each instance, evidence of devotion to the interests of the Association, proof of which I hope will never be wanting.

But, over and above all that has thus been done among ourselves, it is pleasing to see the instances of very praiseworthy efforts made in this direction, by one or other of our members, in their own localities. To my mind, it is a refreshing sight to see a gas manager occupy the platform in the Lecture Hall, or Assembly Room, of his own town, as a lecturer on the recondite mysteries of light, and heat, and fuel, gas-burners, and gas-cooking, and the endless variety of matters connected with coal and its formation, character, and uses, its distillation and products, the tar and its dyes, the ammoniacal liquor and its salts. And while desiring, above all things, to avoid being invidious, I cannot refrain from mentioning, as cases in point, the names of Mr. Wood, of Hastings, whose lectures I have read with pleasure and profit; Mr. Macrae, of Dundee, and Mr. West, of Maidstone, whose recent appearances as lecturers in their own towns, explaining in a forcible way to their fellow-townsmen, without telling them so in so many words, what fools people are to use burners which will not allow the light-giving matter which the gas contains to be made available for its purpose, and who, while grumbling at the price of gas, voluntarily or in ignor

ance, pay twice as much for their light as they need do, by wasting one half of what they buy. And lastly, as the most recent instance of the kind, the brilliant example set by the South Shields Gas Company, in getting up, at no small cost, such an exhibition of gas-cooking and heating apparatus, as has never before been witnessed or attempted, and which I attended as your representative, and gave to it the stamp of your approbation, in my official capacity, feeling certain of your approval. This important and practical exhibition was conceived by our excellent friend, Warner, who was most ably, and with far-seeing wisdom, seconded by the chairman and directors of his company; and we may well hope the good example will be followed by other companies, for the information thus spread cannot but bear good fruit.

The State of Commerce and the Relations of Capital and Labor.

But while gas companies have been thriving, commerce generally has been languishing; the high tide of prosperity, which, for several years past, has enabled the Chancellor of the Exchequer to lighten the burden of taxation, seems to have been seriously checked, if indeed it be not turned, and on the ebb. The great demand for our national staples, coal and iron, has slackened very seriously, and a time of general depression appears to be imminent.

It is painful, under these circumstonces, to witness the infatuated struggles going on here and there between employers and employed, the one urging the necessity for a reduction in the rate of wages, and the other demanding a rise, with the shortening of the hours of labor. The dispute on these points, between masters and men on the Clyde, has brought about the serious result of the enforced idleness of about 30,000 men in that district, the cessation of the means of earning sustenance for their families, and paralyzing the trade of the district. The same cause and the like effects, have also led to a serious derangement in the colliery districts of Northumberland, where one declared object of the men was to diminish the output of coals, with the view of forcing up the price; some 12,000 hands are said to be idle there, instead of being busy, as they might be, earning, by honest labor, fair wages for the maintenance and comfort of their families.

We are thus painfully reminded of the time when the shipbuilding trade was, by such suicidal folly, driven from the Thames, and the miserable spectacle was seen, of empty shipyards and workshops, with all the attendant miseries, of starving families and deserted homes. And we can but ask—Is all such experience useless? Will men still go on under the influence and control of trade unionism dictation—ceasing to judge for themselves, surrendering private judgment, and act as they may be ordered by those who rule the trade union societies, instead of disposing of their labor and skill in the open market on terms satisfactory to themselves. and those who obtain the orders for ships, for willing hands to build, and machinery for skilled artizans to produce?

It does not appear to occur to those multitudes of working men who are under such guidance, that, just as an important branch of industry may be, and often has been, driven by "strikes" from one locality to another, to the ruin of many, so it may be driven from this country, never to come back; but this is the issue now at stake on the Clyde. Those who want to buy ships cannot get supplied on that river because the masters have been compelled to close their yards, so the buyers must seek what they want in another market; and thus the trade may be driven from the country, and possibly return no more, the change involving a national disaster, through the operation of what may be truly called the *curse of this country*—namely, trade unionism.

These, however, are not the only considerations connected with the labor market demanding our attention, and by which the interests of gas companies may be seriously affected. The fact is patent to the world, that the purchasing power of money is less than it was a few years since. The logical consequence of this is, that more money must be given for whatever we have to buy, whether it be labor or materials, or manufactured articles; and in this way the value of a gas undertaking, like any other real property, is enhanced, and in all recent sales of gas property, by companies to corporations, this has been felt even where it has, perhaps, not been seen or understood, the general increase in the value of such property being practically equal to the diminished value of gold, which has been estimated by competent authorities at about 20 per cent., the increased production of gold having had this effect.

Purification of Gas from Sulphur Compounds.

Within the last few days, a decision has been given by a committee of the House of Commons, on "the sulphur question," which has recently been again debated, and voluminous evidence given thereon, before that tribunal, two Bills having been brought before it, one by the Crystal Palace District Gas Company, and the other by The Gaslight and Coke Company, the object of each company being to obtain relief, from the expense and inconvenience, of complying with the requirement to eliminate, what are called the sulphur compounds from the gas, to such a degree, that not more than twenty grains shall be found in 100 feet, and both bills have been rejected, thus leaving the companies as they were.

The question has been, whether the public suffer more from the nuisance arising from the use of lime, or from the sulphur compounds, when lime is not used as a purifying material.

When oxide of iron alone is used as a purifying agent, the only sulphur compound removed is H_2S (sulphuretted hydrogen), a most offensive smelling and injurious gas; but every one of you well knows that there are other sulphur-holding compounds which are present in gas, the principal, and the only one, the existence of which has been completely demonstrated, is bisulphide of carbon, CS_2. It is conjectured, and we have very strong reason to believe, that sulphuretted hydrocarbons are also present in coal gas. Now, the removal of the CS_2, or, at all events, a large proportion of that which exists in ordinary coal gas, is a comparatively easy matter. But, so far as we know at present, there are no chemical means of taking out the sulphuretted hydrocarbons.

CS_2 is what chemists call a weak acid, and it has the power of combining, with other sulphuretted compounds, such, for example, as sulphides of calcium and ammonium. Now, when it is desired to remove as completely as possible this CS_2, the gas manufacturer has, as a preliminary step, to get a purifier charged with sulphide of calcium. Then, the gas being carefully purified from carbonic acid, the CS_2 it contains, enters into combination with the sulphide of calcium, and is detained. This process is arrived at with the greatest success, at the Bow Common and Beckton works of the Chartered Company.

The same thing may be done, to an almost equal extent, by the use of strongly sulphuretted ammoniacal liquor, care being again taken to remove the carbonic acid in an early stage of the process, as practised successfully at the South Metropolitan works by Mr. George Livesey.

The objection recently raised before Parliament is, that it inevitably occasions a nuisance in the neighborhood of the works, by the removal of the lime. The purification of gas in close vessels involves a nuisance in a much less degree, and it is highly desirable, that the process of purification should be so conducted, as at all times to avoid, if possible, giving cause of offence to those who are fastidious, respecting perfumery; but the great object of a gas manager should be, so to distil his coal, as to create, or set free, and send forward in his gas, as small a quantity of these obnoxious products as may be possible, or practicable, and here, in my opinion, there is room for improvement in our common practice.

Formerly, say twenty-five years ago, when iron retorts were in common use, the practice was to distil coals at much lower heats than have been common since that period, with the use of clay retorts.

I need not trouble you with any remarks or reasons to show how, and why, the use of clay retorts involves the necessity of what may be called the high-heat system, because, as practical men, you can hardly fail to know that the two—that is, clay retorts and high heats—are inseparable: but I may take this opportunity of putting forward a theory which I believe will be proved to be perfectly sound and reliable; hence I give it as my well-considered opinion, that our common practice of charging clay retorts on the scoop system, is the source and main cause of all the difficulty involved in the "sulphur compound" agitation.

The coal being laid in a thick mass, the outside is over-cooked before the interior has been sufficiently acted on by the heat of the oven, and this is productive of mischief, not known in the days of iron retorts, by the expulsion of the obnoxious compounds which formerly were left in the coke; hence I state it as my belief, that the way to overcome the difficulty of not being able, by any known purifying process, to take them out of the gas, is by not, in the first instance, putting them in. And I have been led to this conclusion, by observing that this is done, in common practice, by West's system of charging, the coal being deposited in a thin stratum, and worked off in four hours instead of six, the heats and the quantity being the same as, on the scoop system, would require six hours.

The Electric Candle.

As regards the electric lights the public have recently been led to expect great things and cheap things, from a Russian inventor, M. Paul Jablochkoff, who has devised a candle which is to give the light of at least 100 other candles, and cost less than gas, thus casting our poor gas-burners, the pride of our hearts, into the shade, in more ways than one. And, full of hope that it might be my happy lot to be able to communicate to you, some pleasing information respecting this wonderful invention, I applied, in my official capacity as your president, for permission to attend a private exhibition of it, and an invitation was very courteously sent me by the agent of the proprietors of the patent, Mr. R. Applegarth.

But, unfortunately, what was intended did not come to pass. Some two hundred gentlemen, interested in scientific matters, attended at the appointed time and place—namely, at 9 o'clock in the evening of the 5th inst., at the West India Docks, and after waiting till half-past ten, were obliged to leave to catch the last train to the city, without seeing that for which they had put themselves to no small inconvenience. The cause, as we were informed, was the break down of a steam engine, without which, the electric generator could not be worked.

Assuming, however, that the thing had been a success, its superiority over other electrical lights would have been a matter of degree. The inconvenience of a light too powerful for the human eye would still remain, and the light from one burner would require to be reduced, by shading, to about one-fifth of its power, to render it admissible for the ordinary purposes of life, thus reducing its value, while the cost of production would remain the same. It is thus obvious, that if the light of 100 candles be produced, and 20 only are available, the 80 are obscured and wasted. And there would also remain the fatal objection of its not being diffusible, besides all which, its cost must be such, as to put out of the question its becoming a rival to coal gas, until some means be devised for *collecting* electricity, instead of having to employ steam power for its *generation*.

Nevertheless, such lights are undoubtedly highly desirable and valuable for certain purposes, such as lighthouses, large spaces, submarine work, and a variety of other possible uses, and we should hail with pleasure the improvement of the electric light, as we should any other addition to the comfort, profit, and advantage of the human family. But I think I may safely say, that there is not the slightest probability of property invested in gas undertakings being affected in value by any kind of electric light; and that the fear of any such result can only be seriously entertained by the ignorant.

I cannot, however, leave the electric light without mentioning the fact, that Dr. Siemens has successfully grappled with the difficulty previously felt in connection with the carbon points being kept at the proper distance apart, and which, till recently, was effected only by a clockwork arrangement.

I had occasion, a short time since, to visit the extensive iron works of Messrs. Head, Wrightson & Co., at Stockton-an-Tees, and saw there a lamp invented by Dr. Siemens, by which the carbon points were kept in their proper position automatically, and was informed by a member of the firm that they had found it very useful in the construction of an iron girder bridge, 250 feet long, the girders being 26 feet deep, upon their works, whereas without such an appliance they could not have kept their men at work upon the structure by night as well as by day last winter.

DEATHS OF MEMBERS DURING THE PAST YEAR.*

We have to regret the loss by death, since we last met, of Joseph Braddock, of Fairfield, near Manchester; John Chester, of Swinton; C. B. Darwin, of Ulverstone; J. T. B. Porter, of Lincoln; and William Fraser, of Inverkeithing.

I had not the pleasure of a personal acquaintance with the first four gentlemen in this mournful list of five, whose loss we have to lament, but I had the happiness of knowing our departed friend Fraser, of Inverkeithing, whom to know was a pleasure and privilege, and it was with a feeling of profound regret that I heard of his removal from among us. We can all well remember his familiar countenance, marked by intelligence and inspired by good will, his manly, common-sense, and kind-hearted tone of mind, generous sentiments involuntarily escaping from his tongue; and of him it may truly be said that "The law of kindness was on his lips."

POSITION OF THE ASSOCIATION.

Five members have withrawn, from various causes, leaving 594 on our list this morning, we have now added 55, making our number now 649.

I beg now to invite your attention to the fact, that the expenditure of the Association has somewhat exceeded the income for the past two years, which I am confident has only to be mentioned to be corrected, and the balance made to appear on the right side of the account; simply by some of those of our number who have been in the habit of subscribing half a guinea—from a feeling of delicacy, and the avoidance of anything like ostentation towards those who can only afford half a guinea—just doubling their annual subscriptions.

And in reference to the expense of our members leaving their homes to attend the annual meetings, I venture to think it will not be out of place for me to refer to the excellent letter of our friend Hartley, which appeared in the JOURNAL OF GAS LIGHTING three weeks since, reminding those directors of companies who have not hitherto considered the matter, that the ofttimes valuable information picked up by their managers through attending these meetings, is an addition to their previous stock, which is available for the benefit of shareholders and consumers alike, and thus would fully justify the payment of such expenses out of the revenue account of the company, and it is my earnest hope that we shall not again hear of any managers having to attend the annual meetings at their own cost.

NEW WORKS IN PROGRESS.

It only remains for me to mention, as illustrating the progress which is being made in the designing and construction of vessels and apparatus required for the manufacture and storage of gas, that a gasholder to contain 3,100,000 feet, to work in a brick tank—the largest in the world—has been designed by our friend Mr. Woodall, of London, for the Phœnix Gas Company, a description of which I hope we may, in due time, be furnished with, if, indeed, we may not have the pleasure of holding one of our annual meeting in the tank. The contract for this monster holder has been entrusted to Messrs. Cutler and Son, of Millwall, the construction of the tank having been undertaken by Messrs. John Aird and Sons, of London. Also the fact of a station-meter being in course of construction for the London Company, by the Gas-Meter Company, on what is called the Reliance principle, to pass 250,000 feet per hour; and another, by Mr. Sugg, for the Fulham station of The Gas-Light and Coke Company, to pass 200,000 feet per hour.

And while on the subject of meters, it is pleasing to find that the inventive faculties of our members are directed towards the attainment of absolute perfection in registering the consumption of gas under varying circumstances as to speed, pressure, and water-level. The Reliance meter has been designed with this view, and Mr. Hunt, of Birmingham, has also come to the front with a new arrangement for producing the same result.

THE SUNDAY LABOR QUESTION.

I am pleased to hear that the movement set on foot by Mr. Morton, to diminish Sunday labor in retort-houses, has been continued with growing success, the management of many works having been conducted with zealous regard to this object.

ESTABLISHMENT OF A BENEVOLENT-FUND.

I cordially congratulate the Association upon the support accorded to the scheme for the establishment of the Benevolent-Fund, the principle having been adopted, and above £800 subscribed, the particulars of which will be reported to you by our secretary, when you will be asked to adopt the rules, which have already been circulated among the members.

And now, gentlemen, hoping I have not trespassed too much on your patience, I invite your attention to the business of the meeting.

PREMIUMS FOR PAPERS,

The President—Gentlemen, I have now to inform you what premiums have been awarded by the adjudicators, for papers read at the last annual meeting. Three of the four premiums only have been allotted.

The first, of £10, was awarded to Mr. Richards, for his paper on "Retort-Seeings;" the second, of £7, to Mr. Hunt, for his paper on "Washers or Scrubbers;" and the third, of £3, to Mr. Fison, for his paper on "A New Self-Regulating Exhausting Apparatus."

Mr. R. W. Brett (Hertford) read the following paper on

THE SUPPLY OF GAS TO PUBLIC LAMPS.

In bringing this paper before your notice, I feel I have undertaken a task to which I am unable of myself to give full justice; but I trust it will be the means of promoting a discussion or inquiry, in which we shall have the opinions of some of our more experienced members, thereby making it more authoritative, and paving the way to more profitable results.

There can be no disputing the fact that the system itself is not carried out with any universal arrangement; but the means adopted form a labyrinth of ideas in some cases almost difficult to conceive. We have had a number of papers on subjects from the retort house to the burner, defining the causes of the loss of gas; but I am led to think that a very considerable amount of it passes off through that troublesome consumer the public lamp.

I have to thank a number of brother members for their replies to my queries some time ago, and it is upon these replies I have to rely for no small amount of the information I shall produce. Some of them were supplemented with accounts of frequent troubles with the local authorities; and I deem myself (as questions were only asked of members of our Association) in duty bound to give an account of them, to the best of my ability, without stating name of town or authority. I have not included gas undertakings owned by local authorities under any heads but those of governors and meters.

The main points, then, are the services and standpipes, meters, taps, governors, and burners, the fixing and repairing of the same, and the conditions on which the gas is supplied to the local authorities; and as any one of these is worthy of a paper, I am compelled to condense each of them.

Firstly, then, as to the services, no one can dispute the advisability of these being the property of those supplying the gas. But that this rule is not universal is proved in the fact that, in no less than 88 instances out of 243 they belong to the local authorities, and among the remaining 155 the gas company only claim to the foot of stand-pipe in many cases, the local authority repairing all above ground. The supplying, fixing, and repairing in a number of instances is done by painters, plumbers, gunsmiths, blacksmiths, and, in fact, most inexperienced men are employed by both gas companies and local authorities to perform this most important work. It matters not to such wheth er gas escapes or not; all they care is that the pipe is put out of sight, and that gas passes through to the burner, they know their bill is safe. The employment of such labor cannot be too fully deprecated. Those supplying the gas should insist (as a condition of supply) on fixing and repairing the service, even if it is to become the property of the local authority, but on no account should they be allowed to interfere in any way, though they are very apt to assert that they can do as they like with their own property.

It is very essential that none but skilled labor should be employed, and that it should be the labor of those supplying the gas, inasmuch as there is naturally more interest taken by them than by outsiders. The tools and the fittings, too, should be the best, for a badly tapped main, or a badly threaded pipe, would prove the source of as much escape as a badly welded tube. To secure all this, the authority supplying the gas must have the entire control of all the services. To ensure a good supply, the service to a lamp should not be less than three-quarters of an inch, attached to the main by a connecting piece, and having a tee-piece and plug at the bottom of the stand pipe.

A number of suggestions have been made and plans adopted for the preservation of services, especially for the hungry, damp, gravelly soil. Some propose that the pipe should be encased in a box or trough, filled with sawdust and tar; others pitch, tar, and paint; whilst some put the plain pipe into the ground, without making any provision for its preservation. Now, the troughs, though very effective, are rather too costly for small undertakings, and as for bare painting or tarring, it does not answer. The method I adopt is to have all wrought iron pipe, when new, covered with a coat of good paint, and, when laying it into the ground, mix some tar with the earth, making, as it were, a tar concrete round the pipe. I think this will prove effective, but I almost question whether some tars alone preserve the pipes at all. I have found some very much eaten into when only tar has been used; but, let whatever methods be adopted for their preservation, they are futile when rust has commenced its work, hence the necessity of well painting the tubes when new.

The stand pipe from the service to the tap should not be less than half an inch, and inside the column, as also against the walls, should be wrought iron; any metal used in the brackets must not be less than three-eighths of an inch in the bore; copper or brass should not be used; in fact, iron throughout is the best. Care must be taken that the internal pipes of a lamp column are firmly fixed, and I should recommend that at the annual, or other, examination the pipes should be taken out and painted, as some of them will be found more rusted than if exposed to the open air. The stand pipes against walls should also be well painted. The usual plan is just to bedaub the part seen, which is really that least needing it, as the dirt, cobwebs, etc., encourage the moisture between the pipe and the wall, and excessive corrosion is the result. As the painting is generally done by contract these in no way mean points are entirely overlooked. To prevent escape when examining the stand-pipe of a column, a small india-rubber plunger attached to a ¼-inch rod may be used; it will also answer for a guide for refixing the pipe in its position, into which it may be lowered as painted.

* A letter from the President, which appears in our "Correspondence" columns, points out an omission in this record of deceased members.

The next things we have to consider are the meters. Some suggest that the average meter system should be adopted, others not; and to prove that this is a question far from settled, I may say that in 296 instances only 80 use meters—viz., 59 gas companies and 21 local authorities, leaving 179 gas companies and 37 local authorities not using them. Where they are used by the companies they are charged at a rental. As to the average number, it varies; for instance, in two cases a meter is fixed to every lamp, and as a set-off to that, one or two use it at the rate of one to every 100 lamps. But leaving out these exceptions, the average is one in 14. If the district is uneven, and no district or lamp governor used, I should say, have a meter to every lamp; but if the conditions are the reverse, the less meters the better. But with all this, some are contemplating using, and others discontinuing the use of, meters to the lamps.

Now, surely one system must be right, and there cannot be anything wrong in the meter system, under proper conditions The authorities generally prefer them; at the same time they are the source of a great number of unpleasantnesses and warm disputes. The inspectors of the local authorities often being men ignorant of anything practically appertaining to gas, rush into figures attempting to prove that the company are doing everything to rob the public; and, should it be the lot of the company to light and extinguish—of course they are accused of leaving on metered lamps, or leaving out non-metered ones. If the local authority light, *this* would not be done; these are the chief difficulties to the more general adoption of the system. The conditions, I think you will agree with me, for more effectively carrying it out, are—first, that the meter must show as little as possible the result of friction, not taking more than 1-10th pressure to work it—less, if it can be; the position of the meter must also be taken into account. In a number of towns it is in the base of the column, in some underground, and I have seen some fixed in boxes on the flats of walls. The underground plan is by far the best, from its non-liability to be affected by changes of temperature, which alter considerably the registration, In the event of its being in the base of the column, the lowness of the temperature, especially when the consumption is at its highest—viz., in winter—must be the cause of a great amount of unaccounted-for gas. As to fixing the meters in boxes against walls, I should not at all recommend it for any reason.

Not only must the meter be the more perfect for the average meter system, but the tap, the governor, and the burner must be so also. The full of the tap the Gas Referees put at one-quarter inch, and the minimum pressure at the inlet of the governor at 5-10ths, and at the point of consumption 2-10ths. Most crank-tops in use are apt to get loose at the screw and collar, which tighten the plug into its place, and a liability to loss is apparent, there being sometimes rough usage to them when working stiff, from the torch, and often when the repairs are not under the supervision of the gas company, these leaks go on for some time unnoticed, or, if noticed, not reported. In some cases the screw is loosened by the knife of a lamplighter, and sometimes it is lost altogether. This evil is, in a great measure, met by a crank-tap; I am using one supplied by Mr. Sugg, the plug of which is held in position by a screw passing through the body of the tap into a groove in the plug; I think practice will prove that this is a step in the right course. I am now alluding to lighting by torch, although we have still the ladder in use where the torch would be advantageous.

Next in order follows by far the most important appliance—I allude to the lamp governors—and here alone, from their most importance, is room for a future lengthy practical paper and discussion, for great improvements have been made in them these last few years. I hold them to be essential, and the only safe appliance to lead to the goal of perfection and fairness between the gas company and the local authority as to the gas supply, and if anything will aid the use of meters to street-lamps, it will be the general adoption of a reliable lamp governor. I think with such instruments any zealot of the hourly rate system would give in at once. There are a great number of governors in the market, some of them excellent specimens. But I must commend every one, before he generally adopts them, to make himself thoroughly acquainted with them. I am aware that in some instances the directors will not sanction a slight outlay for testing apparatus, but we must class these among the "penny wise and pound foolish" clique of ignoramuses. For instance, governors are ordered to pass, say, 5 feet per hour of 14-candle gas at a minimum pressure of 5-10ths. The governors come to hand, are tested for consumption at the above and augmented pressure, and they are apparently as required; but accidents will happen, therefore suppose a burner gets broken in springing, or by some other unlooked-for means, the result is that a number of these governors will pass 10 or 12 feet per hour. Now, in such cases as these, it appears they are dependent on the burners to help them, and very often the burners sent with them are not adapted to the gas; for one suited to 30-candle gas at 5 feet per hour would not give the light of a farthing dip of 14-candle gas at the same rate of consumption: hence arises one of the difficulties to the more universal adoption of the lamp governor, which, if a perfect one, should not pass more than its specified quantity, even without a burner. Then the person using the governor can make his selection of the burner best suiting his gas, taking care that it is sufficiently large to pass its full quantity at minimum pressure. Then if, with the governor and suitable burner, say 5 feet per hour can be passed at 5-10ths pressure, and this consumption cannot be increased with augmented pressure, nor can it with the burner out, we have all we require. I have taken 5 feet consumption merely as an example; of course these would vary according to requirements. The 5-10ths pressure would be as low (bar accidents) as one would expect to find even at metered lamps, but I think it essential to have at least 3-10ths margin above the 5, to ensure against little mishaps, &c. It is rather singular that out of 296 authorities supplying gas, there are still 91 using the burner without governors, 15 of these with meters, and 76 without. Some of the burners, very good in their way—such as the Brönner, Bray, Clegg, German, and others—ensure a good combustion, but do not govern. Not only are these burners used, but there is a strange admixture of common bat's wing and fishtail, supposed to consume in quantities from 2 to 5 feet per hour. There is the single jet in Scotland, and there and elsewhere we find union jets—No. 1 calculated to 1 and 2 feet per hour, No. 2 to 4 feet, and No. 3 to 6 feet, supposed to be passing, some one amount and some another, up to 5 and 6 feet per hour. Now, in such instances as these, how are they regulated? Will any of them pass the same at 5 10ths as at 15-10ths pressure? The following table proves to the contrary by giving the increase in consumption in 10ths of an inch.

No. of Burner.	Bronner.	Bray.	Clegg.
3	1.5	2.0	—
4	1.65	2.5	—
5	2.9	3.2	4·3
6	3.5	3.6	4.4
No. of Burner.	**Leoni.**	**Jet.**	**Bat.**
3	3.3	2.4	—
4	4.0	2.9	2.0
5	4.2	3.5	3.7
6	4.4	4.4	4.8

With such burners as these, how are the charges regulated? They are all charged at the same stated rate, and it cannot be disputed that, in some hilly districts, where the district governor is not used, there must be an alarming difference, and also an alarming loss, whether meters are used or not. As an example of the use of one of the better class of burners without a governor, but under the average meter system, showing clearly a loss by using a meter to other than governed burners, I may mention that I once tested and found that at the metered lamp columns there were only 2·75 feet per hour passing, at the columns not metered 3·57 cubic feet, and at the brackets 3·31 cubic feet per hour; or, putting it in plain figures, the company were losing 0·82 cubic feet per hour, or 12s. 6d. per year, on lamp-columns, and 0·56 per hour, or about 8s. per year, on all the lamp-brackets—this, too, with a No. 3½ burner. Now, if so heavy a loss with so small a burner, what must it be where the burners are large, and, perhaps, 2-10ths or 3-10ths taken off by the meter, making, for every tenth, a difference of about 0·25 feet per hour, which, if going on for 4000 hours, gives 1000 cubic feet per lamp per year—no mean item where several hundreds of lamps are used. But this is taking it very low. Where the governor is not used, we are told the light is regulated by sight. I should like to know whose eye is sufficiently practiced to tell the quantity of gas passing through a common bat's-wing, some of which will give a far better light at 5 feet per hour than others will at 10 feet? In such cases the loss must be beyond conception, and hundreds of pounds are lost by the gas companies, the public reaping the benefit. Now, by the use of the governor, all these differences of district, meter, &c., are put out of question. But, as I before stated, there is scope for a separate paper here, still I hope I have said enough to show that the governor is really a necessity in street lighting. As to the use of a meter or no meter where the governor is used, it is immaterial (although I should prefer it), but it is positively essential at every lamp where it is not used.

As to the mode of lighting, I have not much to say, but will leave that to others more conversant with the tried and untried appliances. I think the present almost universal means of lighting by torch will be some time before it is superseded. But who can tell what may be in store? We hear so much of the lime, magnesium, and electric lights—these are days of wonderful advances in science, and none of us can forsee what may be in the future; and it is well we cannot, for we might be almost ready to forsake our trust, and search in other fields of industry.

I have had an automatic lamplighter brought to my notice, and I must confess it is a most beautiful instrument. It is a governor as well as a lamplighter. On turning on the light, the pressure is conveyed from a small jet (where it is kept alight all day) to the burner, which takes up the increased supply of gas. Upon this lighting, the jet goes out, the light at the burner continuing the same at the decreasing pressure of the night. To extinguish the lights the pressure has to be increased, and on again taking it off, the apparatus is so arranged that the holder drops, opening the gasway to the jet and closing it to the burner. I have one here for your inspection; but as I believe there are gentlemen here who have used it, perhaps we may hear more of it.

I should certainly recommend gas companies to light and extinguish the lamps themselves. There are many advantages, they being more readily made acquainted with anything in the shape of leaks, want of pressure, accidents, &c. Out of 237 companies 163 do this work; but some of it is undertaken by contractors in their employ, these also do repairs.

As to the matter of lamp-posts and brackets, I think we may leave them, for it is almost impossible to set any rule for guidance. The local authorities generally direct them to be set up here and there, very often regardless of the position at which the light is required, and we are in many cases bound by their decisions. Some say they should be 70 or 80 yards apart; but this is not to be used as data. Lamps with a fair light and a fair way to shine should not be more than 70 or 90 yards apart; but we find in the densely-populated City of London, 20 yards often nearer the mark. There is no question that towns well-lighted are not so well robbed, for the public lamp is a public guardian always found at his post when properly fed.

It is well on the part of those supplying gas to see that the lanterns are so constructed that the full benefit of light is obtained; for, in many instances, we see about an inch or two of paint, putty, and metal at each of the angles of a lantern, and as much shade as light thrown around. Then there is the very awk-

ward cradle, casting positive shades in all directions. There are some excellent specimens of lanterns in existence—viz., the Catoptric, the Westminster, etc.; but I think these are more for local boards and private consumers in small towns than for gas companies to look to. I know where the introduction of the Catoptric led to the leaving out several of the town lamps; and we provincial folks find the public authorities take every opportunity of leaving lamps out. Mr. Keen, of Hastings, too, has a neat double clipped lamp, which does away with the putty; the glass, too, can be removed whilst painting. But there is the objection in most lamps that they cast too much shade. I have a specimen of one here that I think meets the requirements. There is but one shade cast outwards from it, and that may be kept the wall side. Both the top and bottom frame clip on to the support, which can be used to pillar or bracket The glass is fixed in by clips. The top may be glazed or not, it can be easily taken to pieces, and can be packed in a very small compass.

It does not affect a gas company, whether or not they own the lamp columns, etc.; if they own them they charge for their use. The conditions of supply seem to be the most varying. Some gas companies merely supply the gas; some supply gas and repairs, but do not light; others supply and light, but do not do repairs; and others neither light nor repair, whilst some do all. But I must say again that whether the fittings, etc., belong to, or the lighting is done by, the local authority, the gas companies must, under no circumstances, allow the local authority to either fix or repair any fittings through which passes unregistered gas, and this should be clearly laid down in an agreement, with other matters, which should always exist where gas companies supply local authorities.

The very generally adopted plan is to charge the number of hours consumption at per hour, by a table of lighting, the gas company doing the lighting and repairs. Then there is the yearly rate from sunset to sunrise, the average charges being in the north about £3, in the south £3 15 s., in the west £3 5s., and in the east, including the London district, £4 15s. The highest under this head appears to be £5 5s.

The average charge for repairing, painting and lighting is about 15s 3d. per lamp. I do not consider this sufficient; 16s. is little enough, one or two generous companies do the work for 10s., whilst another charges 23s. Among the charges we find 2d. per lamp per night for gas and lighting, 3s. 6d. for maintenance only, 1s. per lamp per week without repairs, 2d. per lamp per week for lighting only, and 8s. 6d. per lamp per year: 10s. per lamp per year, which is not bad, and we should do well if we could all get it. But all this must be affected in a measure by locality. Still the charge is pretty general. There are a few more eccentricities. We have some towns in which (though there are gas works) the streets are lighted with oil; in another the gas is supplied at cost price, having a loan of money from the town free of interest, and it is given in two cases; ½d. per hour per lamp is another charge. Some put out part and others all their lamps at times varying from nine p. m. till sunrise; some leave out a week before and after full moon; some light three, four, five, and six months only; nine months is a very common time, and there are other mixtures too varying to bring to your notice.

I am sorry that I have encroached on so much time with this paper, but there is in any one of the subjects ample scope for an independent and lengthy discussion. I may add that in drawing up agreements of supply, the chief points that must on all accounts be inserted are, that the authority furnishing the gas should insist on supplying, and fixing, and repairing the services and fittings and on the use of governors, and if the local authority light and the gas is charged per hour instead of meter, the torches should be kept at the gas, police, or fire stations, and notes made of the time they are taken out and returned. I now place the facts in your hands, hoping that, by the aid of my more experienced seniors, general good may accrue therefrom.

Mr. A. F. Wilson (London) thought it would be very interesting if they could get at the bottom of the question as to the expense of laying a separate system of mains for the supply of the public lamps. If it could be done the lamp consumption would then be determined by a station or large meter at the outlet, and the disputes as so the variations of consumption now continually arising would be settled for ever. Most of the members present remembered the transitions which had taken place in the modes of supply, from the system of contracts at so much per lamp per annum, double taps, governors, average meters, etc., and referring to the meter system, he might remark that it seemed to him, if they had to put a meter to every lamp, they might as well go to the expense of laying a separate main far the special supply of the public.

Mr. J. Johnson (London) said for a great many years he had been much troubled with this question of the supply of gas to public lamps, and he had come to the conclusion, after trying almost every scheme, that the only way to get along comfortably was to adopt the average meter system. He knew, from a great many experiments made during the past year, that gas companies had been serious losers by the ordinary contract system of lighting. Year after year he had taken down hundreds, and in some years thousands of governoas and burners for the purpose of testing them; and. after getting the best governors and burners that were made, he found great variations in the quantity of gas consumed by them. About four years ago, in the city of London, a bold statement was made by the chairman of the Gas Committee of the Corporation, that although the gas company were receiving payment for five feet of gas per lamp per hour, the consumption was odly 3½ feet. He (Mr. Johnson) thereupon suggested that they should appoint some independent person to test the governors, to ascertain what the actual consumption was. The Gas Committee accordingly appointed Mr. Heisch for the purpose, and the matter was left entirely in that gentleman's hands to select which of them he would experiment upon. In the result it was found that, instead of consuming only 3½ feet per hour, as was stated by the chairman of the Gas Committee, they averaged 5·7 feet per hour. At one time he was always having complaints made as to the irregular way in which the lamps were lighted in those parishes in which the average meter system was adopted, but now all such complaints had ceased, and those who formerly had the charge of doing this work had their minds entirely at rest on the subject, for they could answer any expressions of dissatisfaction by saying, "The matter is in your own hands; the gas company are not responsible; and if you have anything to complain of, you must go to the local authorities;" a very desirable state of things for a gas manager. With regard to the average meter system, no doubt there did arise certain little irregularities; but so far as his company were concerned, they had reached that happy condition that they were more nearly paid for the gas consumed than they ever could be under the old system. He felt persuaded that it would be a great benefit to gas companies generally if they could introduce the average meter system, inasmuch as they would not only thus get paid for the gas actually consumed, but they would get rid of the continual complaints of the local authorities in respect of the public lighting. He did not think he could enter very largely into the questions touched upon by Mr. Brett, further than to say that the system adopted with his company was this: They took charge of laying the services; after the services were laid the meters and fittings were provided by the local authorities, and there were very stringent regulations as to the maintenance and repair of these things. The company had an inspector in each district, whose duty it was to go round and see that everything was in good order. The meter, they found, was a great indicator of the state of the burners generally. They knew very well if the governors were properly constructed and well regulated, and were working well, on those lamps which had no meters, by the results indicated by those which had meters. They took out the meters once a year to test them, and they had an arrangement with the local authorities by which those bodies were required to test their governors once a year. It was also done occasionly by the company's own officers in conjunction with theirs, and such governors as were found to be slightly irregular, say, beyond one per cent., were taken out, readjusted, and set right. This continual readjustment secured for the gas companies, in his opinion, a much nearer approximation to a correct registration of the gas consumed by the public lamps than any other plan which had been adopted. As to the suggestion of a meter to every lamp, that, he though, would be a very great and quite unnecessary expenditure, and as to the proposition of laying a separate main for the public lamp service, he did not think there would be much gained by it. The main would necessarily be smaller than that in use for the general consumption, and therefore more liable to breakage, more liable to leakage from the joints. Looking at the question from all points of view, he thought the system would be an extravagantly expensive one to adopt as compared with the system now in operation, and he should certainly expect to find that the unaccounted-for gas would be very much increased. He had some experience with small mains in London. A great quantity of them were laid down by the late Great Central Company, and when they came under his supervision some years ago, he found them to be in a terribly bad state indeed. He could not go a hundred yards, even where these mains were laid under the footway, without finding broken joints and much consequent leakage. As the fruit of his experience, extending over a long period and a considerable district, he was clearly of opinion that the adoption of a system of small mains for the exclusive service of the public lamps would lead to a large increase in the per centage of unaccounted for gas. On the other hand, he was fully convinced that the adoption of the average meter system was the best solution of the difficulties hitherto experienced between the authorities and the companies in reference to the public lighting question.

Mr. Carr (Halifax) said he was one of those happy individuals whose lot is was to serve a corporation, and, therefore, it might be supposed that this question did not much affect him, but was only of interest to gas companies. Still, corporate officers were affected by it. The Lighting Committee of his borough were the Highway and Watch Committee; they bought gas from the Gas Committee for the public lamps, and some little differences arose at times as to the proper measuring of the gas, and the proper way of supplying it. The lamps were supplied on the average meter system, and there were governors to every lamp. The district was a very irregular one, and the pressure varied from 5-10ths to 50-10ths. He had lately been trying some experiments to ascertain the consumption of the public lamps. On removing the governors he found the average consumption throughout was 4·1 feet per hour, testing at 8-10ths pressure. when the governors were replaced, the consumption was 3·5 feet, on the average of the whole. He set a man to watch the metered lamps to see the exact time they were lighted and put out, and in that way he succeeded in getting another quarter of a foot per hour in those lamps. Something might be said about the meters taking off a certain amount of pressure, but still the pressure over the whole district was much higher than what he had been testing at, and it was one of the things he had not quite satisfied himself about, that governors could be so relied upon under varying conditions of supply, such as in his district. He was much pleased with the paper which had been read It gave a large amount of statistical information, and furnished some interesting details of the various modes of supply adopted, from the most primary which was still retained in some places, down to the most improved plans which experience had devised. He agreed with the writer when he said that some burners were so defective that the companies lost half the gas supplied to them; but he did not agree in his further remark that the public reaped the

benefit of it. In truth, no one derived benefit from it. The miserable burners employed in some towns for the consumption of gas in public lamps were a perfect disgrace at the present time of day. And in reference to the disputes which sometimes arose, he thought that if the local authorities better understood their business, and, instead of railing against the gas manager, wou d try and obtain information for themselves as to the best conditions of gas supply, not only would the companies be benefited, but the public would be better satisfied. There was one point in the early part of the paper to which he wished to refer. Mr. Brett, speaking of the importance of the preservation of the service-pipes, said the method he adopted was to mix a quantity of tar with the earth in which they were laid, so as to make a sort of tar concrete all round the pipe He would like to ask Mr. Brett how many pounds of tar per yard he would require to imbed his pipes in, supposing tar to be a good thing to apply to wrought iron services, which, he thought, was not quite proved. To him it appeared to be rather a lavish system, when tar commanded a high price, to employ it in the preservation of lamp services.

Mr. Warner (South Shields) said he did not gather from the paper what proportion of metered to unmetered lamps the writer advocated. As to the laying of the services, there could be no doubt that if a thing was worth doing at all, it was worth doing well, and he could not understand that the lavish mode proposed, of pouring tar in unlimited quantities around the service-pipes, amongst a lot of loose damp earth, was at all comparable to the plan of laying the pipes in troughs, and filling them up with melted pitch. He quite agreed with Brett that the fittings should be entirely in the hands of the gas company. He had maintained for many years that they should have entire control over the gas, With reference to the cocks used for public lamps, many of them had no means of indicating whether the supply was on or off. He had had his furnished with a little pointer, which was turned upwards when the gas was on. In addition to the ordinary washer and nut, he had a thumb-screw, so that in cold weather the lamplighters could keep hold of them.

Mr. Bates (Worksop) said he thought that, when adopting the average meter system, the fewer meter in use the better. He would as soon have 1 in 20 as 1 in 12. As to having a separate main for the public lamps, he was sure it would not be worth the expense. It would, as Mr. Johnson said, add to the leakage considerably, and would yield no permanent benefit. Some three years back the lamps in his town passed into the hands of the local board, and there appeared to be a question whether they should buy the lamps from the bottom of the stand-pipes or from the main. He suggested that it should be from the bottom of the stand-pipe, but the chairman of the local board would have it from the main. He, therefore, inserted a clause in the agreement that the services should be thoroughly examined, and, if any defects were discovered, that they should be repaired at once; and that, if not attended to by the local authorities, they should be repaired at their expense by the company. He thought it was best to lay service-pipes in troughs filled with sawdust, and he could state that some taken up by him within the last six months, that had been laid nearly 30 years, were as good as ever. As to the position of the metered lamps he regarded it as of little consequence; the registration would be nearly the same so long as good governors were in use.

Mr. G. Anderson (London) said he was not an advocate of the average meter system, and he felt bound to give his reasons for not adopting it, seeing that so experienced a man as Mr. Johnson had given in his adhesion to it. First, then, in order to be paid for all the gas supplied under that system, it was necessary to have in the mains an extra pressure of about 2-10ths beyond what was required when no meters were in use, and this additional pressure caused increased leakage at the unmetered lamps. He did not agree with the writer of the paper that the local authorities were ignorant. On the contrary, he found, as a rule, that they were very acute, and required a considerable amount of looking after. There was a gentleman present on this occasion who had the charge of lighting a large city of 100,000 inhabitants on the average meter system. This gentleman informed him that there was a continual complaint in the city that the local authority were in the habit of sending round and turning out the metered lamps an hour or two before the regular time, so that the gas company were put to the expense of having to employ men to perambulate the streets during the night to put a stop to these proceedings. For such and other reasons he (Mr. Anderson) could not approve of the average meter system. He believed there were only two methods that could satisfactorily be adopted—one was the system very wisely advocated by Mr. Hawksley—that of having a meter to every lamp, or the laying down of a separate main for the public lamp service. He did not see that it followed there would be more leakage from having a separate main, because under that system a meter would be put down at the gas works to measure all the gas supplied to the main, and it would therefore be to the interest of the local authority to see that the main was sound, and the company would be paid for all the gas registered as having passed the meter. But really it was not necessary practically to have a separate main in that broad sense. Why not have one meter in the middle of each street, with pipes supplying 10 or 20 lamps each, branching out from it, and one small main for each section. This would give almost the same result as now was obtained with a meter to every 10 or 12 lamps. No doubt, under the old system, the companies supplied much more gas to the public lamps than they were paid for, and it was important some improvement should be effected upon that state of things.

Mr. Coles (Todmorden) thought the public lighting never would be satisfactory until the supply of gas came under corporate management. One difficulty in connection with the meter system was the influence of frosty weather upon the meters.

Mr. Copp (Wrtchet) said in his town, until about two years rgo, the company entered into a contract for the supply of gas at so much per lamp, but since then the authorities had introduced the meter system with painful results to the company, for it had actually reduced their returns 50 per cent. The claim was set up on behalf of the local authorities generally, that because they were large consumers, therefore they should be supplied at a lower rate, the fact being lost sight of that each lamp, requiring a separate service, was a distinct source of leakage as well as expense. He thought more attention than hitherto should be paid to the burners employed in the public lamps.

Mr. Wilkinson (Harrogate) said he had some little experience, not only with regard to the meter system, but also, for one year, in relation to the supply of the public lamps with petroleum oil. The company to which he belonged supplied the public lamps by contract for some years, using the best burners they could get, and they offered to furnish governors to the lamps and to keep them in repair, provided the commissioners paid the first cost of them. This they refused to do, and at last the parties got into such hot water, that the local authority determined to discontinue the use of gas, and light the streets with petroleum oil. He was glad they did so, and he would advise all his brethren in similar circumstances to let it be done; the authorities would soon get sick of the experiment. His company had always calculated that there was a very serious loss by over-consumption in the public lamps, when supplied without meters, and, in proof of that, he might mention that during the year the lamps were lighted with petroleum, the company were enabled, by the saving of gas alone, to pay half the bonus to their shareholders. Reference had been made to the difference between the metered and unmetered lamps—probably there was some little difference—but he believed that, where proper meters were used, and properly fixed and charged with glycerine and water, there was no danger of any great difference arising. The adoption of the average meter system in his town had given great satisfaction to the local authority, and to the company likewise. The former purchased the posts from the company, and laid their own pipes under the company's supervision, and under agreement that they should be such as met with their approval. The governors professed to fix the consumption at five feet per hour, and the experience of their working was that they gave an average result of 4¾ feet. The commissioners at one time had it in contemplation to lay a main of their own for the supply of the public lamps, and to take all the gas through a single meter. He wished they had done so, beacuse then the company would have been saved all the leakage on the lamp-services; but they found upon investigation that the cost of such a main for their three hundred and thirty lamps would have come to something like £3000.

Mr. Edwards (Thornton) had had the average meter system at work for three or four years to between 300 and 400 lamps. The company forced the adoption of it upon the authorities on their bringing against them a charge of fraud, and since the first quarter's bill went in there had not been a single complaint of any kind. In fact every one was satisfied. With regard to the remarks made about the difference of consumption between the metered and unmetered lamps, he had taken a course different, perhaps, to some members. He tested every governor by putting it upon an experimental test-meter, and all those which would not stand an increase of 10-10ths of pressure, without altering the registration, he rejected. The result of that was that he had got paid for 93 per cent, of all the gas he made.

Mr. Livesey (Ventnor) differed from Mr. Anderson in reference to the average meter system, and was decidedly in favor of that mode of supply to the public lamps. For some years he was secretary and manager of the gas and water works in his town, and was also surveyor to the local board. The disputes and squabbles arising out of the contract system of lighting were interminable, and it appeared that the company could never give satisfaction. The local board consisted of eighteen members; there were three newspapers in the town, and every member was fond of writing to them. The company lighted the lamps, cleaned them, extinguished them, and supplied the gas for about £3 per lamp per annum, during eight months of the year, every night, from sunset to sunrise, except five nights at the full moon. About six years ago, when the contract was about to terminate, they intimated to the board that they could not renew on those terms, and suggested the adoption of the average meter system. Several interviews took place on the subject, and, as he had the confidence of both parties, he was asked to draw up an agreement. He did so, the arrangement was made, and they had gone on very amicably ever since. Under this arrangement, the company still had the control of the services from the main to the burner. The local board paid for the stand-pipes, governors, burners, &c., and kept them in repair. They also provided wet meters, specially adapted for the purpose, in cast-iron cases, which were fixed beneath the pavement. The number of meters was one to every six lamps. The district was a very heavy one, the variation in level from the sea being 360 feet. They had no governors. The local board kept the lamps in repair, lighted, cleaned, and extinguished them, and for the quantity of gas supplied they paid at the same rate as that charged to the private consumers. As he had already stated, there had been no dispute at all between the company and the board since this agreement had been made. But there was one circumstance which he thought had rather pleased the ratepayers, but about which he thought the local board had rather hoodwinked them. When the company lighted under contract at so much per lamp, they kept the lamps alight from sunset to sunrise, but directly the local board took the matter in their own hands the lamps were extinguished at one o'clock: now they were extinguished at eleven o'clock. The ratepayers, of course, had not so much to pay for the gas through this retrenchment; but the company had no reason to complain, as they received

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THURSDAY, AUGUST 2, 1877.

nearly as much for the public lamps now as they did when they were kept burning till daylight. As a word of advice to members, he would caution them, in adopting the average meter system, not to put too few meters, especially in some districts.

Mr. Brett, in the course of his reply, said he did not think his plan of laying services was open to the observation of lavish expenditure, as he only used about a gallon of tar to every ten feet of pipe, at a cost of about 2d. There was no necessity to fill the whole of the trench, but only just round the pipe, with the tar. He thought the general opinion in the meeting seemed to be in favor of the meter system, especially if governors were not used. As to the number, his own idea was that one to 14 lamps was sufficient, and this he found was above the average.

The President said the members generally would agree with him that they were much indebted to Mr. Brett for bringing forward this subject. His paper had elicited a great amount of information from one and another in the way of recapitulation of personal experiences, which, no doubt, would be of general benefit. It was a very fruitful subject, and had borne fruit in the way of suggestions as to what to do and what not to do, what rules to observe, what errors to avoid, and how best to meet difficulties in the supply of gas to the public lamps. With regard to Mr. Wilson's remarks, he (the President) did not sympathise in the notion of supplying the public lamps through a separate main. It would involve a very large expenditure, and the interest on the capital would more than balance any saving that could be effected, to say nothing about the additional leakage, and the friction which would take place in a small main of that kind. But this was a matter which each could settle for himself; given any town, to ascertain how much main would be required to be laid for this service, and how much the cost would be. In some cases he apprehended it would amount to half the cost of the public lighting. Looking at it from all points, he was not himself inclined to the adoption of this plan. On the contrary, he objected entirely to having two mains in the streets. It should be a great point with every company to have abundant main capacity. By using large mains instead of small mains, the unaccounted-for gas was reduced because the supply of gas could be given anywhere in the district at the lowest potential pressure—*i. e.*, the initial pressure at the works. This he held to be a very important consideration. Assuming the mains were properly laid and properly cared for, then he would say—"See how economically you can supply gas at the lowest pressure when the consumers are all gone to bed, and no one up but the public lamps." He knew from experience that very great economies had been effected by carefully watching the pressure after eleven o'clock at night. In some towns, of course, where a night train was due at twelve o'clock, that must be the time; but his advice was, wherever practical, reduce the pressure to the lowest point after your consumers meters have left off working. With regard to some remarks made by Mr. Anderson, it was a matter of congratulation to see Mr. Anderson in such excellent form. He was always vivacious and lively, and incisive; but, *query* whether the alteration in the old state of things ought not to modify one's old feelings of—well he would not say unkindness, because gas men were never unkind to any one. But seeing that a great many corporations had bought works belonging formerly to companies, they might now be regarded as occupying the position of companies in former times. They were bound to manufacture and supply gas, and the Gas Committees had to see that the Lighting Committees paid for all they consumed in the public lamps, and it was a matter of congratulation that corporations had been brought to supply gas on sound constitutiona principles. Now, with regard to the average meter system, which did not find favor with Mr. Anderson, he (the President) would say for himself that having been a bitter opponent of it, and fought many battles for the companies against it, he now approved of it. Some 30 years ago, in a town with which he was connected, he found the old principle in vogue of bribing the corporation by supplying gas to the public lamps at a lower price than to the private consumer. His first stroke of business was to increase the charge to the public lamps 15s. per annum, and reduce the price to the private consumers. A meeting of the corporation was held, and he was asked to attend. There was a great deal of vigorous speaking, and when he got a hearing he said: "I am not putting this 15s. into my own pocket: I am taking it from you and putting it into the pockets of the consumers, and I say that the old system of charging less to the public than the private consumers is not justice and equity. It is not a sound commercial principle that you should pay 4s. while the private consumers pay 6s. You say you are a large consumer, but I say that, taking each individual case—and I treat each lamp as a single consumer—you are a small consumer. You pay only £3 per year for each service, whereas I have consumers in this district who pay £150 for a single service. Although, therefore, we know that the corporation may always be relied upon to send their cheque to the secretary of the gas company as soon as the amount is due, yet there is the leakage on the public lamps to be taken into account—and service-pipes are a greater source of leakage than mains; therefore (I said) you must put up, for the common good, for the good of those whose representatives you are, with having a wholesome and honest and consistent state of things established." In that case the corporation were men of such common sense that they actually said "Amen" to everything he brought before them. And he believed managers would find, as he did, that after all, common sense, if only applied properly, would prevail, and that if they did the thing that was right, they would in the end, to employ a rough expression, "shame the devil." It must be always borne in mind that the saving effected in the public lighting was a saving, not so much for the benefit of those who supplied gas, as in the interest of the consumers. Everything by which the company could economize, and by which their profits were improved, was so much to the good of the private consumers. A company might be able to sell gas at 6d. per 1000 less if they had not to maintain an unreasonable and stupid loss from the lighting of the public lamps. Therefore, in arguing the public lamp question, they were arguing a question in the consumers interest, and in which they were themselves disinterested. Referring to the observations of Mr. Johnson, the president said he had heard of Mr. Johnson as one of the best abused men in connection with this matter, and therefore he was pleased to find that his troubles had not made him shrink away. It was good to see a well-abused man preserve such a rotundity, and retain a spirit so genial. Mr. Johnson spoke more strongly in favor of the average meter system than some others, and believed it to be the most conducive to a satisfactory settlement of all disputes between the companies and the local authorities. There was no doubt the system had had this effect; it had established the principle, brought it to the front, and confirmed it, that the public consumer, the corporation, or the local board should pay a price for the public lamps, not less and not exceeding that charged to the largest private consumer. This principle was now sanctioned by parliamentary procedure.

[To be continued.]

Lighting by Electricity.

[Translated from the "Journal des Usines a Gaz."

M. Denayrouse has presented to the Academy of Sciences a note relative to the suppression of carbons in the production of the electric light. This invention which has excited considerable attention, is due to M. Jablochkoff, and consists in introducing into the central circuit of an electro-magnetic machine, the interior wire of a series of induction coils, and in causing a spark from the induced current to pass on to a plate of kaolin placed between the two extremities of the exterior wire of each coil.

The electric current is first of all made to pass to a kind of priming of greater conducting power disposed upon the edge of the plate of kaolin; this latter is heated, becomes red hot, and eventually luminous

M. Jablochkoff hopes by this means to succeed in producing as many as fifty luminous focuses with a single electro-magnetic machine.

Such, briefly summarized, are the terms of the communication made by M. Denayrouse to the Academy of Sciences, and subsequently repeated by him at a sitting of the Society for the Encouragement of National Industry, at which we were present. We are thus enabled to speak of this invention with some knowledge.

We ought to say, at the outset, that the idea of M. Jablochkoff is very ingenious, and that the experiment is a very interesting one from a scientific point of view, and very pretty to see in a lecture-room; but we will add that it does not appear to us to possess any chance of success in practice. We shall give our reasons presently.

Let us commence by stating that M. Jablochkoff is not the inventor of the pretended *divisibility of the electric light*, as we cannot reasonably give this name to the production of several intense focuses with the machine or the same pile. This pretended divisibility has no connection with the *indefinite subdivision* of the light of gas.

This idea of the divisibility of the electric light belongs to Mr. King, whose English patent is dated November 4, 1845, and it would be difficult to say whether that gentleman's process is not superior to to that of M. Jablochkoff. The basis of the invention is the employment of metallic conductors, or continuous carbons, raised to a white heat by the passage of an electric current. When carbon is employed, the graphite from gas-retorts is brought into use, it being rendered incandescent in a tube in which a vacuum has been produced. When the current is of sufficient intensity, a certain number of lights may be placed in the same circuit, taking care that the power of the machines, or of the piles, shall be in proportion to the number of lights to be obtained. In this way what is called *lighting by incandescence* is produced.

This process had for a long time been forgotten, when M. Lodugvine, a Russian physicist, invented a small lamp, constructed on the same principle, which was perfected by MM. Konn and Bouliguine. Then came the remarkable invention of M. Joblochkoff, upon which we are about to dwell at greater length,

in analyzing the method of lighting the Magazine du Louvre, and the experiments made at the Society for the Encouragement of National Industry.

M. Jablochkoff's apparatus has been fitted up with the object of lighting the Salle Marengo, situated between the Rue de Rivoli and the Rue St. Honore; this is effected by means of eight electric "candles," surrounded by globes, thickly painted a zinc-white color to soften and diffuse the light, and provided with reflectors to direct it. These candles are composed of two parallel carbon points 0·004 of a metre (0·15 inch) in diameter, and 0·12 of a metre (4·72 inches) long, insulated by a plate of silicious material; they are fixed upon two copper tubes, and fastened together by a tampon of asbestos. These points are brought into communication by means of a small piece of charcoal, which serves for the lighting of the candles.

The apparatus is set in operation by two of the Alliance Company's electro magnetic machines, each equal to 250 Carcel lamps, and driven by two six-horse power steam-engines.

This part of the Magasins du Louvre is usually lighted by eleven gaseliers. having altogether 74 globe burners, each consuming about 100 litres (3·5 cubic feet) of gas per hour.

In order to compare the two modes of lighting, a visit must be paid on several consecutive evenings, not only to the Salle Marengo itself, but to the opposite footway in the Rue de Rivoli, in order to judge well of the effect.

The first thing that will be noticed is that the electric light is not in action every evening, and even when it is it never continues so for the entire evening. This observation is very important, because it is by not taking it into account that persons are led to bring forward imaginary net cost prices, giving the advantage to the electric light.

In fact, if the electric light is not in action every evening, it is either on account of certain inconveniences attending its use, or because the apparatus has to be repaired; but if, on the other hand, when the light is in action, it is only so for a portion of the evening, it is because it is not economical.

Now that simply results from the fact that the electric light is indivisible, while gaslight may be divided indefinitely. In fact, what takes place in an establishment like that of the Magasins du Louvre? At dusk the gas-burners are lighted, but are kept turned down to a small jet; as the evening advances they are opened in proportion to requirements. Similarly at closing time, when the public are no longer admitted, the shopmen and others require light for clearing away and arranging the goods, though this work does not necessitate the large consumption required when the establishment is full of customers. A certain number of lights are therefore extinguished. and the others lowered so as to obtain only the necessary amount of light. Finally, when the place is closed, light is still required for the clerks and cashiers, but a few jets only are necessary. Nothing of this kind is possible with the electric light, which is always at its highest illuminating power, or if not, expends almost as much carbon and motive power as though it was.

The consequence is that the gas-burners remain alight (small jets, it is true), even when the electric light is in action. Therefore double fittings and double expense are necessitated on the one hand, and on the other, the net cost per hour of the electric light cannot be arrived at by calculating the interest and depreciation of the apparatus in the footing of a number of hours lighting equal to that of the lighting by gas, since these apparatus are in use for a portion only of this number of hours. Or rather the expense of the two methods of lighting must be compared not with the equality of light, which is absolutely of no signification, but by taking into account the fact that the superabundance of electric light during certain hours is quite useless, and consequently lost, since it cannot be lowered and the expense reduced.

It is somewhat difficult, for several reasons, to appreciate exactly the difference in intensity between the two methods of lighting. First of all, as we have just said, the gas is never entirely extinguished; then a large amount of light is furnished from the neighboring galleries; lastly, the color of the light is altogether different. However, by standing on the opposite footway, it will be noticed that with either system of lighting the articles and customers in the shop are equally well distinguished. It may be admitted, therefore, that the eight electric candles of M. Jablochkoff are equal to the 74 gas-burners; and in the case of the former giving a superior light, this extra light would be superabundant, since the idea of increasing the number of burners has never been conceived.

Let us then give the comparative net cost of the two systems of lighting:

By Electricity.
(Expenses of First Establishment.)

	Francs.	Sterling.
Two probable 6-horse power steam Engines	12,000	£480
Two Alliance electro-magnetic machines	16,000	640
Conducting wires and M. Jablochkoff's apparatus	2,000	80
Total	30,000	£1200

Being at the rate of 15 per cent. per annum, for interest, depreciation, and maintenance, 4500 francs (£180).

By Gas.

	Francs.	Sterling.
74 burners, at 25 francs each (including meter and service-pipes*)	1,850	£74

Being at the rate of 15 per cent. per annum, for interest, etc., as above, 277 fr. 50c. (£11 2s.)

We will admit 500 hours lighting in the year for each system in operation separately.

By Gas.

	Fr. c.	Sterling.
Interest and depreciation	277 50	£11 2
74 burners, burning 100 litres (3·5 cubic feet) per hour for 400 hrs. at 30c. per cubic metre (35·3 cubic feet	888 00	35 10
74 burners, burning 50 litres (1·75 cub. ft.) per hour for 100 hours, at 30c. per cubic metre	111 00	4 8
Total for the year	1276 50	$51 0

Being at the rate of 2f. 55c. (2s.) per hour.

By Electricity.

	Francs.	Sterling.
Interest and depreciation	4500	£180 0
Coal (1·50 kilogramme per horse power per hour, at 40 frs. per 1000 kilogrammes) for 500 hrs.	360	14 8
Stokers, 400 hours, at 50c. per hr	250	10 0
Graphite points, at 36c. per hour	180	7 4
Lubrication, at 13c. per hour	65	2 12
	5355	£214 4

Being at the rate of 10f. 71c. (8s. 6d.) per hour. That is to say, the cost of lighting by either system is in the proportion of 1276·50 : 5355 = 100 : 419. The electric light, therefore, costs more than four times as much as gas.

If, on the other hand, we compare the two systems as they are now working in the Magasins du Louvre—that is to say, either gas alone, or the electric light concurrently with gas burning low for several hours, and burning alone for the remainder of the time—we arrive at the following figures:

Gas Alone.

	Fr. c.	Sterling.
Annual expense, 500 hours, as above, or 2f. 55c. per hour	1276 50	£51 0

Gas and Electricity.

	Fr. c.	Sterling.
Interest, depreciation, and maintenance of fittings (gas)	277 50	£11 2
Ditto (electricity)	4500 00	180 0
500 hours lighting by gas (small jets)	555 00	22 4
200 hours, lighting by electricity, at 10f. 71c. per hour, as above	2142 00	85 14
Total	7474 50	£299 0

* We do not speak of the value of the gaseliers, which is altogether independent of the lighting, and would be identical for the two systems, in the case of luxurious fittings being employed.

Being at the rate of 14f. 96c. (12s.) per hour. That is to say, the cost of lighting by either system is in the proportion of 1276·50 : 7474·50=100 : 586. The mixed system of lighting is, therefore, more than five times as dear as the gas alone.

There are other inconveniences to be pointed out in M. Jablochkoff's system applied to the lighting of large retail establishments:

1. The "candles," being composed of carbon which burns and of a silicious matter which volatilizes, produce a white smoke, formed of very fine particles of silex. which, as is well known, has a very injurious effect upon the respiratory passages,

2. The "candles" have to be removed every half hour.

3. The white light produced by electricity, which, it is true, allows the stuffs to be seen in their natural colors, is very unfavorable for the selection of those stuffs when they are to be viewed by artificial light, whether it be gas, candles, or lamps. With regard to those that are to be seen by daylight, it is more simple to select them during the day.

Finally, the faces of the visitors wear a pallid hue; and upon this point it is necessary to take the opinion of the ladies, which is altogether unfavorable to the electric light.

A few figures will still further demonstrate the absolute impossibility of bringing the electric light into general use in an establishment like that of the Magasines du Louvre, which, however, appear to be the best adapted for the employment of this system of illumination. We have seen that the lighting of the Salle Marengo required 74 gas-jets, and that to replace these, two six-horse power steam-engines, driving two Alliance electro-magnetic machines, were required. Let us generously admit that this system of lighting replaces even 100 gaslights. Now, the Magasins du Louvre employ altogether 3000 lights, to replace which, therefore, a motive power of 360 horses and 60 of the Alliance Company's electro-magnetic machines would have to be employed. It will thus be seen that it would be necessary to erect a complete works, and the cost of the ground alone would render the application of this system of lighting impracticable.

We will conclude this article by quoting a few passages from a very interesting volume by M. Fontaine, on the subject of lighting by electricity. This well known electrician says, in page 126 of his work:

"Manufacturers who only pay 30c. per cubic metre for their gas, and who find their establishments sufficiently lighted with twenty burners, should not seek a more economic light, unless they keep their works going every night without interruption."

Then on page 226 he says:

"We assert that from a practical point of view * * * * notwithstanding the remarkable works of M. Jablochkoff, and the no less remarkable initiative taken by M. Denayrouse, there is no lighting system in existence at the present time (May, 1877) which is simple in application, or which could be recommended for a preliminary trial and *a fortiari* for definite application."

Further on he says:

"We believe that for such great efforts to be crowned with success, it will be necessary to discover a new source of electricity, or find a means of utilizing atmospheric electricity for industrial purposes."

Finally, on page 227, he says:

"The error committed by inventors is in wishing to make the employment of their apparatus too general, and immediately talking of suppressing gas lighting. True, electricity has already an immense field of operations. But from thence to taking everywhere the place now occupied by gas is a distance which will very probably never be completely traversed. We have never so much admired the *facility of employment, the simplicity of fitting up, the indefinite divisibility, and the multiplicity of uses of gas*, as since we have been occupied with lighting by electricity."

We have never said anything else.—*Journal of Gas Lighting.*

Spectrum of Electric Light.—M. P. Desains finds that the spectra of electric light are very similar to those of the solar rays. They are less extensive, particularly on the side of the violet; but the curves of intensity exhibit but slight differences in the region of greatest heat.—*Jour. Franklin Institute.*

Speculation in Gas.

We should be glad to see an open and honest competition in the supply of illuminating gas, so that consumers might derive some benefit from it, and be free to take gas from whichever source should furnish the best and cheapest, but past experience in this and other cities gives no encouragement to favor new companies which generally begin with fine promises and end in some combination that makes the monopoly more oppressive than before. We are now getting an eighteen candle gas from the old Albany Gas-Light Company at $2.50 per 1000 cubic feet, and some speculator in a newly projected company, is soliciting from our citizens their signatures to an agreement binding them to take sixteen candle gas from the projected company (if established) at $2.35 for a term of years. While nominally fifteen cents cheaper, yet considering the difference in proposed quality, the promised new gas will in fact be no cheaper. Even if this agreement should be carried out in good faith, it will therefore secure no real advantage to the consumers, but in view of the inevitable further fall in prices, our citizens should be warned to not make any contracts for the specific price proposed for any term of years, but to maintain their freedom to take such gas as is not only the cheapest, but the best, for one qualification has a bearing upon the other. The citizens of Poughkeepsie were visited in this same way, and to-day the new gas company is selling to those who subscribed at $2.70, while the old gas company is selling at $2.40, and the unfortunate people have no redress.

The People's Gas Company has not proved a blessing to our citizens, and it is by no means sure that another would do any better. At all events, it would be highly imprudent to make contracts for a term of years at any such price as $2.35 for sixteen-candle gas. We do not wish to see the streets torn up again to lay a new set of mains for any such purpose. The pressure of public opinion through the Evening Times has forced the old Albany Gas-Light Company to make three reductions in price during the past fifteen months, until it is now brought down to $2.50, which is as low as it is being supplied in the city of New York, and twenty cents cheaper than the projectors of a new company here are supplying it in Poughkeepsie. If there were but one company now in Albany, we should probably be getting our gas at $2.25, for the larger the quantity any one company supplies the cheaper it can be afforded. The more gas companies there are to divide the patronage, the higher is the price likely to be, for whatever they may say at first, they are sure to confederate and combine together in the end Private speculators look only to their own selfish interests, and all experience teaches that the only way to compel private gas companies to be reasonable in their charges is to vest the city authorities with power to establish public gas works.—*Albany Evening Times.*

Light on the Subject.

For the past several weeks our citizens have been deprived, by the action of the City Council, of the use of gas in our streets, and during this time they have learned the necessity of this mode of lighting up the city. Some sixteen years ago when gas was first introduced in Talladega it was considered or regarded as a kind of luxury, something very nice to have, but not at all necessary. This idea has long since been exploded, as surely it should be. No town or city as large as this can be comfortable and pleasant to its inhabitants, or attractive to strangers, that is enveloped in darkness every night. Every man who owns property or does business here is directly interested in having our city lighted by gas. It serves as a protection against burglars, and the general misdeeds of evil disposed persons. The bright gas light, such as we now have the promise of having, prevents many a heinous crime, is a great aid and benefit to police supervision, and hence is a potent auxiliary to the moral and religious interests of the community.

Looking at it in this the proper light, the gas company is a benefactor to Talladega, and ought by all means to be sustained liberally and generously by all our citizens, as well as by the city authorities.

We are glad to learn that Messrs. T. G. Foster and J. T. Jones, of Montgomery (both gentlemen of considerable experience in the gas business), have just completed the purchase of works, etc. here, and propose to remodel and otherwise greatly improve them during the summer months. They will extend the main pipes up and down the streets, and our people should encourage this introduction of foreign capital into the city, by sending in their requisitions to become consumers as soon as these pipes pass their houses. We can safely state that when the proposed improvements are complete, no city in the State will have a purer, better, or more brilliant article of gas than Talladega.

In considering the many advantages accruing from the use of gas, we should not lose sight of its safetiness, cleanliness, and convenience. It does away with the miserable makeshifts of dull glimmering candles, of unpleasant smelling and dangerous coal oil lamps, and the snuffing of wicks and trimming of smoky burners, together with the constant dread and knowledge that you had at your elbow, or above your head, an element more destructive to human life than a torpedo. We will say no more on the subject at this time, we know the people will appreciate these many benefits, and sustain this useful enterprise. The City Council has concluded a very advantageous contract with the new company, for lighting the public street lamps for a term of five years, and it now remains with the people to do the rest.—*Talladega (Ala.) Mountain Home.*

New Means of Defence Against Torpedoes.

The most valuable means of defence is that of illumination. Light of sufficient power to disclose any object attempting to enter a cordon of illumination around a ship, the ship itself remaining in darkness, is at once the simplest and most effective precaution that can be devised against night attack. The employment of the electric light or of the ordinary modes for this purpose is impossible. Yet if a sufficient and persistent illumination can be maintained at a given distance from a ship, no torpedo launch or boat would venture to approach it. The launch would be doomed for destruction, being a mark for the gunner, and if it can be prevented from approaching within the range necessary for the launching and effective impact of the Whitehead or other similar torpedo, those missiles would become comparatively valueless.

Within the last few weeks a very important advance has been made towards solving this problem of illumination at sea, by an adaptation of what is known as the Holmes' distress signal, in the form of a shot, for illuminating purposes, to be fired from mortars at ranges varying from 500 to 2,500 yards. These signals possess the remarkable property of emitting a very powerful white light the moment they come into contact with the water, and when once ignited are absolutely inextinguishable by either wind or water, and burn with a persistency that is almost incredible, thirty or forty minutes being an average duration. The shot containing this light is constructed so as to be buoyant upon the water, and, at the same time, with sufficient rigidity of form to withstand the concussion of the powder. Upon striking the water at the required range, the shot, floating up to the surface, immediately bursts into a brilliant flame, with great illuminating power. Some half-dozens of these shots fired from an ironclad or gunboat, would effectually surround her with an impassable cordon of light at any required range, and by such a device, while the vesstl herself would remain in darkness, the enemy's movements of attack would become plainly discernable, and any attempt to break through the illuminated zone of light be at once detected, however dark the night.—*British Mail.*

New Otto and Langen Engine.

The gasmotors of Otto & Langen are subject to several inconveniences in spite of the fact that more than 4,500 of these engines were sold from the factory at Deutz, near Cöln, at the end of 1876.

To enumerate these inconveniences one must mention—

1. The complicated structure of the device used in producing the revolution of the fly wheel—consisting of racks, ratchets, friction clutches, etc.,—easily getting out of order and requiring repair.
2. The unpleasant noise produced.
3. The fact that they could only be applied as vertical engines.

The new engine of Otto, as Prof. Rühlmann informs us through the *Hannov. Wochenblatt*, entirely surmounts these difficulties by presenting a simple and noiseless little engine having a horizontal cylinder, with connecting rod, crank, and fly-wheel. The engine permits of two revolutions of the fly-wheel to every filling of the cylinder, although the connecting rod is keyed directly to the crank on the axle of the fly wheel without the use of geared wheels. When operating, a cushion of air is formed in the cylinder at the end opposite the fly wheel at every stroke of the piston. The valves in the cylinder head are held in place by means of strong spiral springs. The admission of gas and air is regulated by means of a slide and valve, the necessary movement being obtained from the crank in a manner similar to that in the ordinary steam engines. The ignition and consequent explosion of the mixture of the gas and air is accomplished by means of a gas jet, as in the old engine.

The cylinder is kept cool by means of a small current of cold water. It is professed that the consumption of illuminating gas per hour and per horse power is about three-fourths of a cubic meter. The prices and dimensions of the machines are as follows.

Horse power.....	½	1	2	4	6	8
Revolutions per minute.....	180	180	160	160	150	150
Price in marks....	1000	1500	2100	3000	3800	4500
Length of the machine in meters.	1.80	2.60	2.46	2.94	3.18	3.42
Breadth	.85	.90	1.02	1.18	1.30	1.44
Height.....	1.40	1.51	1.62	1.71	1.80	1.85

—*Deutsche Ind. Ztg.—Pol. Review.*

Gas Stocks.

Quotations by W. R. Scott & Co., Bankers,

24 Pine Street, New York City.

August 2, 1877.

☞ All communications will receive particular attention

	Capital.	*Par.*	*Bid.*	*Asked.*
Gas. Co.'s of N. Y. City.				
Central, Westchester	466,000	50	90	95
Harlem	$1,850,000	50	95	100x
Manhattan.....	4,000,000	50	195	200
Metropolitan.....	2,500,000	100	130	132
" Scrip ...	$1,000,000	..	100	103
" Bonds..	500,000	1000	92	94
Mutual.....	5,000,000	100	92	94
" Bonds, gold.	900,000	1000	105	—
Municipal.....	1,000,000	100	70	80
New York.....	4,000,000	100	125	130
Suburban, W'stch'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	150	160
Citizens.....	1,200,000	20	75	80
" Scrip	320,000	1000	95	97½
Peoples.....	2,000,000	10	35	40
" Bonds ...	$ 325,000	...	--	95
" Scrip	300,000	...	75	80
Metropolitan.....	1,000,000	100	65	70
Nassau.....	1,000,000	25	80	85
" Ctfs.....	700,000	1000	96	98
Williamsburgh	1,000,000	50	115	120
" Scrip		...	100	103
Union Co. E. N. Y...		25	—	50

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Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J		100		90
Brockport, N. Y	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	--
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass		25	132	---
Fort Wayne, Ind		100	...	--
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	184	186
Hempstead, L I	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I	25,000	100	...	—
Jacksonville, Ill	120,000	50	82	...
Lewistown Maine	400,000	100	50	85
Lima, Ohi'o	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	100	1?3
Long Branch		20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	-	20
" Bonds	350,000	1000	--	-
Peoples of Baltimore		25	76	—
" Bonds			106	---
Perth Amboy		25	—	95
Rochester, N. Y		100	50	60
Richmond Co., S. I.	300,000	...	95	100x
Woonsocket, R. I	150,000	100	100	...
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'isco Cal.			111	112
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn	50,000	50	—	26
Saugerties, N. Y	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97½

Harlem Gas-Light Company have declared a dividend of 3½ per cent., payable August 6th. Richmond County, S. I., have declared a dividend of 2 per cent., payable on demand. La Clede (St. Louis) gas company declared a dividend of 4 per cent. paid July 1st.

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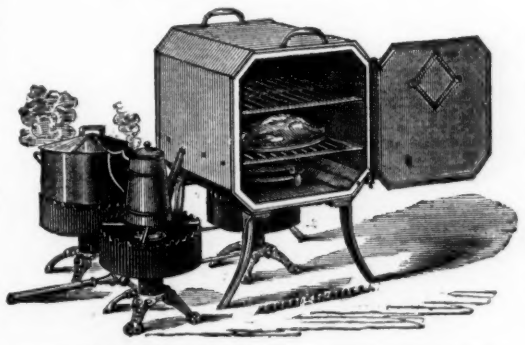
THE RETORT GAS STOVE,



Constructed on an entirely new and scientific principle. By *superheating* the gas before it unites with the air, perfect combustion is obtained, and the same work as other stoves actually done, with 33 per cent. less gas. Does not heat up the room or the person using it. The *entire family cooking* can be done in *half the time* and at *half the cost* of coal, wood, or oil.

Is acknowledged to be the best, and sold by many gas companies.

Send for circular.

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Coal Elevator Co.,
CINCINNATI, OHIO,

Makers and Shippers of the true

YOUGHIOGHENY GAS COAL.

Ours is from the "GAS COAL BED" on the Youghiogheny River, Pennsylvania.

Being first handlers, and having large facilities, we are prepared to make low special rates on Gas Coal delivered on track, at *all Points in the West and North West.*

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Bloomington Gas Co., Ill.	Cincinnati Gas Co., Ohio.
Peoria Gas Co., Ill.	Hamilton Gas Co., Ohio.
East St. Louis Gas Co., Ill.	Piqua Gas Co., Ohio.
Decatur Gas Co., Ill.	Troy Gas Co., Ohio.
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Davenport Gas Co., Iowa.	Gallon Gas Co., Ohio.
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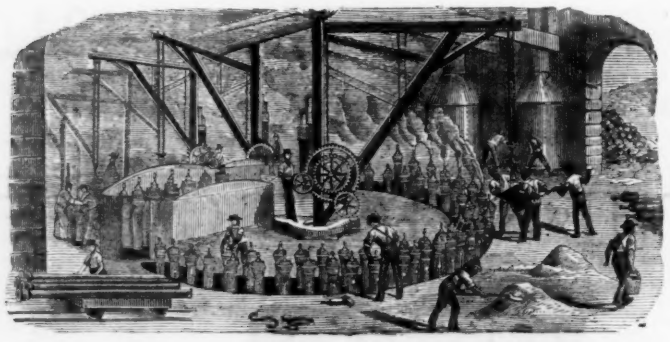
BURLINGTON. N. J,

Flange-Pipes



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GLOUCESTER CITY N. J.

CastIron Gas & Water Pipes, Stop Valves, Fire Hydrants, Gas Holders. &c,

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Foundry, Cor. of York and Moyer Streets,

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Several Thousand 2, 3, 4, 6 and 8 Inch Cast Iron *Gas and Water Pipes* on hand, for immediate delivery.

☞ FITTINGS FOR GAS AND WATER MAINS.

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MANUFACTURERS OF

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(Pipe from three inch and upwards cast *vertically* in 12 feet lengths.)

HEAVY AND LIGHT CASTINGS OF ALL KINDS.

DAILY CAPACITY 125 *TONS.*

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Gas and Water Mains.

All sizes from 3 to 30 inch cast vertically in 12½ feet lengths

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We offer special inducements to parties wishing to purchase. My Pipe is Smooth, regular in weights, and cast vertically.

N. B.—Pipe from 3 inch and upwards, cast in 12-ft. lengths.

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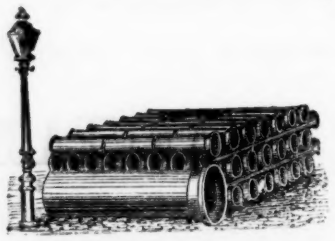

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Enables every Gas Consumer to ascertain at a glance, without any previous knowledge of the Gas Meter, the quantity and money value of the Gas consumed. Also the best method of obtaining from Gas the largest amount of its light.

It will be to the advantage of Gas Companies to supply their Consumers with one of these Guides, as a means of preventing complaints arising from their want of knowledge in regard to the registration of their meters. For sale by

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PEYTONA CANNEL COAL,

FROM WEST VIRGINIA.

Yields over 13,000 feet of Gas per ton. At ten thousand feet (standard yield) the illuminating power is over 43 candles. Purifies **4,510** feet to the bushel of lime.

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Orrel Coal Company,

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Company's Office, No. 52 S. Gay Street, Baltimore, Md.
C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.
CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.
224-1y n

THE DESPARD COAL COMPANY

OFFER THEIR SUPERIOR

DESPARD COAL

To Gas Light Companies throughout the country.

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Mines in Harrison County, West Virginia.
Wharves Locust Point, } Baltimore.
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Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine

*** Reference to them is requested. 204-

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MINED IN TAYLOR COUNTY, WEST VA.

Company's Office, 52 S. Gay St., Baltimore.

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SHIPPING POINT—Baltimore, Md.

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434-1y PITTSBURGH, PA.

GAS COALS.

THE

PENN GAS COAL COMPANY

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For delivery at any Port in the United States.

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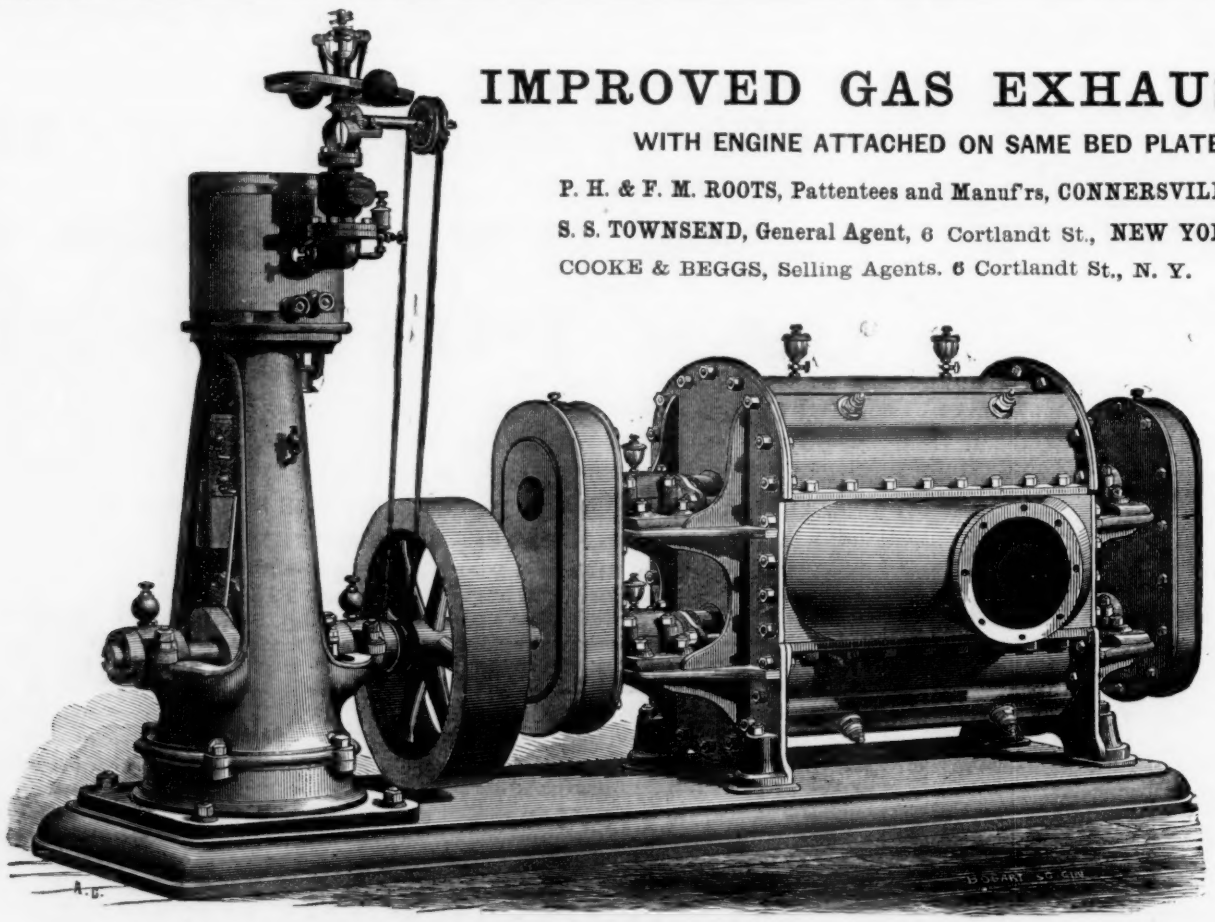

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938 to 954 River Street and 67 to 83 Vail Ave

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BRASS AND IRON SLIDE VALVES.

(Double and Single Gate ⅛ inch to 36 inch—outside and inside screws, Indicator etc.) for Gas, Water and Steam—

HYDRAULIC MAIN DIP REGULATORS.

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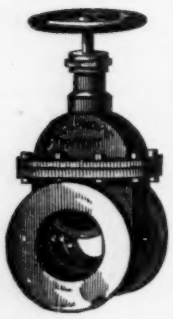

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FIRE BRICK AND TILES,

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☞ Articles of every description made to order at short notice. 1)5

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Ground Clay, Fire Brick and Fire Sand in Barrels,

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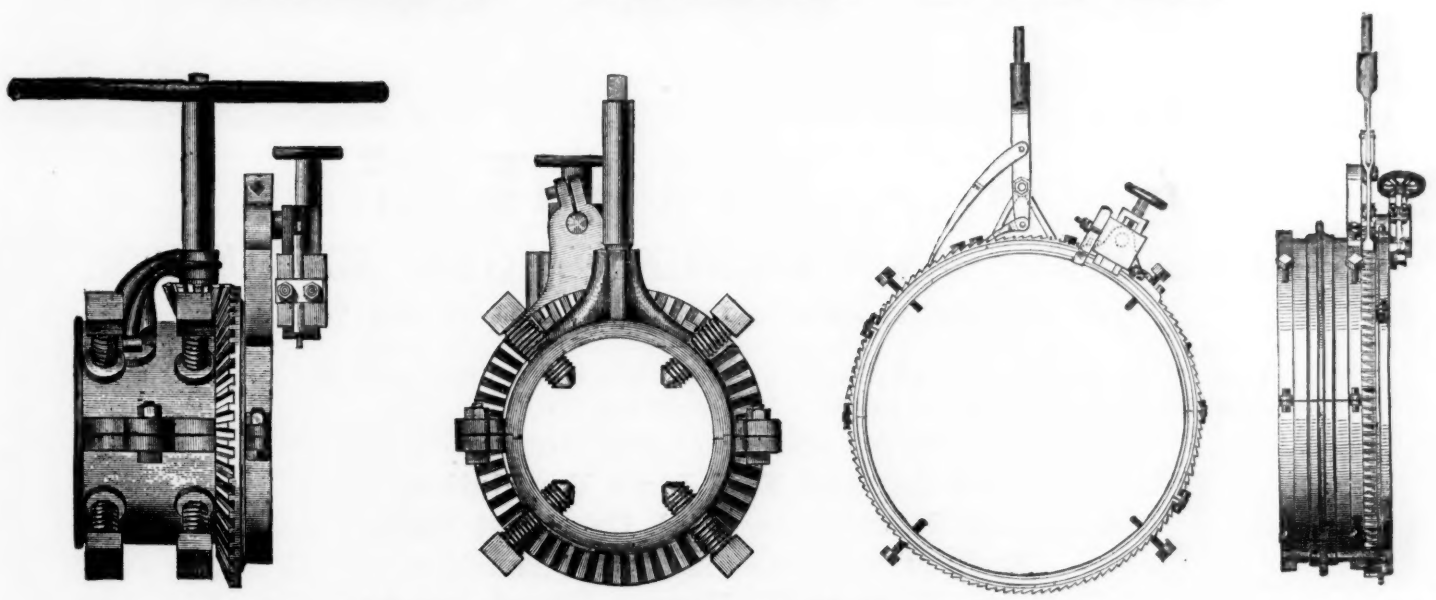
THIS IS THE ONLY HAND MACHINE IN THE WORLD FOR CUTTING

CAST IRON PIPE.



It will cut Cast or Wrought Iron Pipe, Shafts, or Columns of any size, making a clean, smooth, and square cut. Also,

A Continuous Line of Pipe in a Trench or Building.

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Gas Retorts, Tiles and Fire Brick

OF ALL SHAPES AND SIZES.

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OF

300 Cubic Feet Capacity

WITH

WROUGHT IRON COLUMNS,

COUNTERBALANCES, ETC., ETC.,

IN COMPLETE WORKING ORDER.

To be seen at the Works of the

NEW YORK GAS-LIGHT COMPANY,

Twenty-First Street and Avenue A,
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Where full particulars, as regards price, etc. may be obtained.

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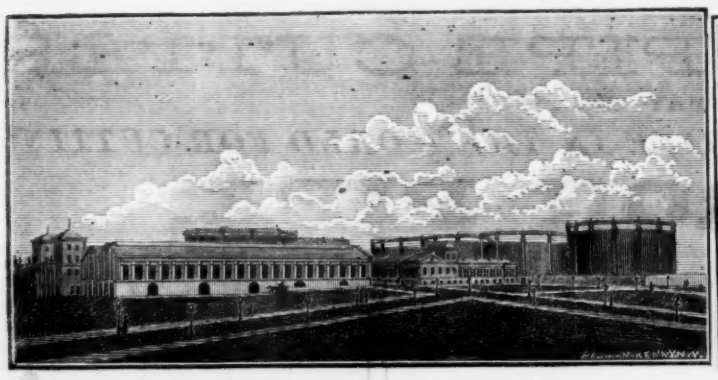
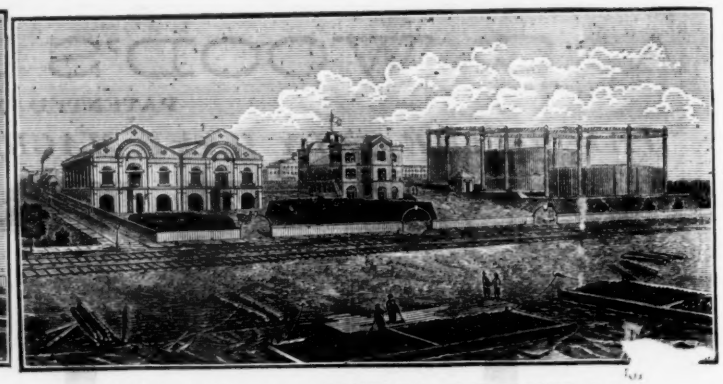


CINCINNATI GAS WORKS. ERECTED 1871-72-73.—WM. FARMER, ENG.



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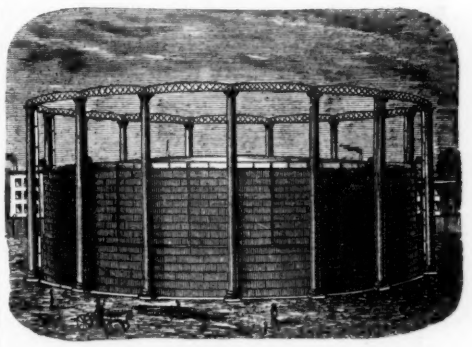

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Signed—A. T. GOSHORN, Director General

J. R. HAWLEY, President

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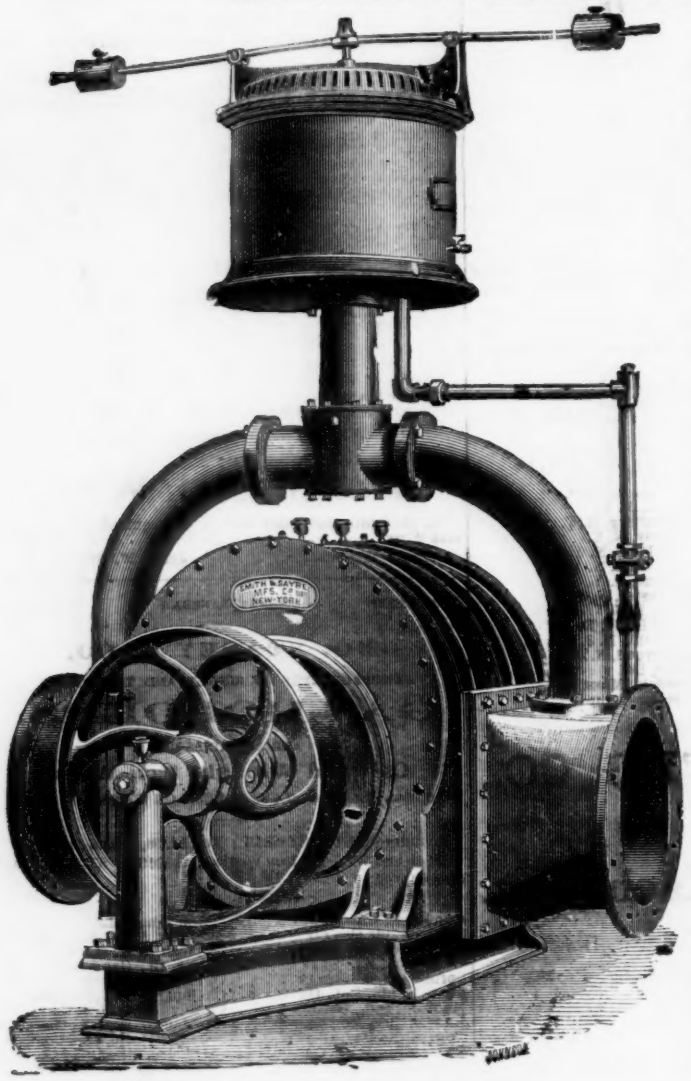

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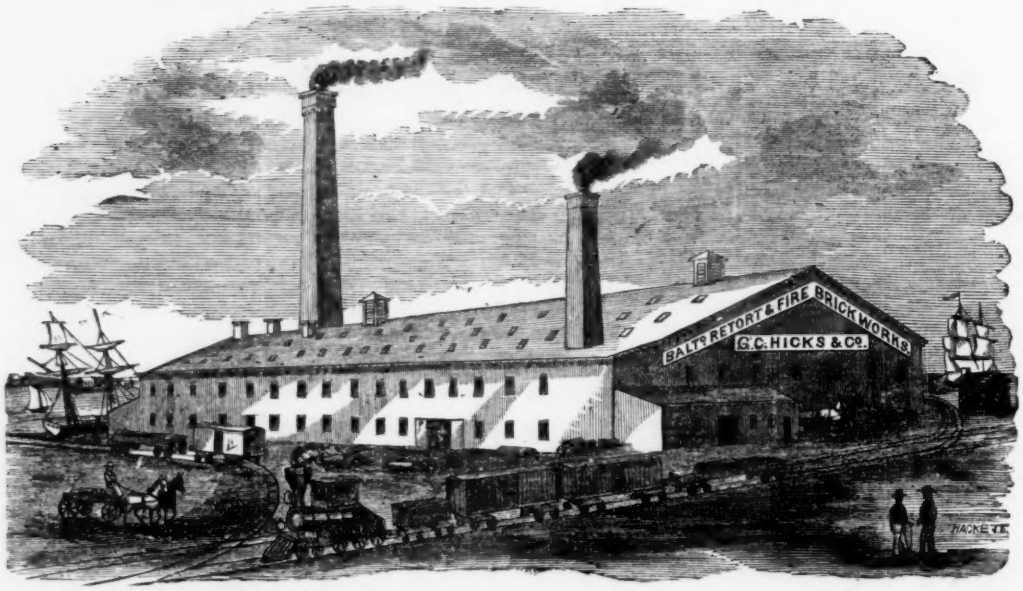

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"GEO. C. HICKS, Esq.,

"Dear Sir,

"Among the letters which you placed in my hands for examination regarding the general standing of your fire clay, gas retorts, and gas furnace, bricks, &c., there were a number from the leading gas manufacturers of the U. S., speaking in the highest possible terms of their durability, freedom from the accumulation of condensed carbon, and general excellence. I regret that these letters are mislaid, or still remain in the Judges' room at the Centennial. I suppose you are aware that your retorts were awarded a First Premium at the Centennial.

"Yours truly, E. T. COX," *of the Centennial Jury of Awards.*